SCIENCE

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*ANNUAL DISCUSSION BEFORE THE AMERICAN SOCIETY OF NATURALISTS.**

THE ATTITUDE OF THE STATE TOWARD SCIENTIFIC INVESTIGATION.

A FAIR criterion of intelligence in the government of a country is afforded by an examination of its annual budget. There is first the provision for a certain number of expenditures which are purely conservative, because the State must maintain itself, it must defend itself, it must support a large class of office holders who are more or less useful. Without knowing the figures it is safe to say that the budget of Russia is chiefly of this order. These expenditures may be wisely and honestly made, but they largely go to waste; they are either immediately productive or altogether non-productive. On the other hand, there are expenditures in the nature of investments, looking to the future and characterizing the most far-sighted statesmanship. Conspicuous among these are the funds invested in education and science.

Said Helmholtz in 1862†: "In fact men of science form, as it were, an organized army, laboring on behalf of the whole nation, and generally under its direction and

* Given at the Baltimore Meeting, 1900.

† 'On the Relation of Natural Science to General Science' (Heidelberg, 1862), 'Popular Lectures on Scientific Subjects' by H. Helmholtz. New York, D. Appleton & Co. 1873. Pp. 28–30.

at its expense, to augment the stock of such knowledge as may serve to promote industrial enterprise, to increase wealth, to adorn life, to improve political and social relations and to further the moral development of individual citizens. After the immediate practical results of their work we forbear to inquire; that we leave to the uninstructed. We are convinced that whatever contributes to the knowledge of the forces of nature or the powers of the human mind is worth cherishing, and may, in its own due time, bear practical fruit, very often where we should least have expected it." Helmholtz in this most influential essay enforces his point by citing Galvani and Galileo and continues: "Whoever, in the pursuit of science, seeks after immediate practical utility may generally rest assured that he will seek in vain. All that science can achieve is a perfect knowledge and a perfect understanding of the action of natural and moral forces. * * * At the same time we must acknowledge that the value of scientific discoveries is now far more fully recognized than formerly by public opinion, and that instances of the authors of great advances in science starving in obscurity have become rarer and rarer. On the contrary, the government and peoples of Europe have, as a rule, admitted it to be their duty to recompense distinguished achievements in science by appropriate appointments or special rewards."

Upon the general contention of Helmholtz as to the ultimate practical importance of pure scientific work, Dr. Galloway will speak from the standpoint of botany and Dr. Howard from the standpoint of applied entomology.

Of European countries Germany places in its budget the largest productive investments of this kind; France is not far behind, England is perhaps fourth and affords a conspicuous example of blindness and fatuity in the matter of unproductive investment; she has, it is true, established textile schools, but has not sufficiently supported technical schools; the cost of a single battleship would establish four splendidly equipped technical schools; England secures the ship and postpones the construction of the schools. All this is through no fault of her prophets of science, who have been as persistent as Jeremiah in foretelling the consequences which are sure to follow.

Yet England gave Darwin his schooling upon the *Beagle;* Huxley secured his upon the *Rattlesnake.* As a sea-faring nation marine zoology appeals to her imagination, and the single notable departure from her short-sighted policy in the encouragement of pure science is the magnificent service she has rendered in the *Challenger* expedition. Our own Dana was trained upon the Wilkes expedition; the French Government equipped the *Talisman*; the German government is supporting the highly successful cruise of the *Valdivia* and its publications under Chun; the U. S. Government has a permanent exploring vessel in the *Albatross.*

In this rivalry of foresightedness the German and French governments have been our keenest competitors both on sea and land, and have probably surpassed us in the recognition of the ultimate economy of pure research. In Germany, quite apart from the extension of the technical school system which to-day is placing her in the lead of all the manufacturing states of Europe, one recalls the annual grant to the Naples Zoological Station. Her most admirable recent action is the subvention of Professor Abbe for his investigations upon optics. Abbe's work was not in the nature of invention, but of research and discovery in the highest sense resulting in the production of an illuminating stage, apochromatic and achromatic immersion lenses, which have fairly revolutionized biology. What we owe to these lenses in a theoretical sense could not be stated in a single

volume and the economic value is equally immeasurable.

The distinctive feature of pure science is that it is not remunerative; the practical rewards and returns are not the immediate objects in view. On the other hand, the work of Tyndall and Pasteur on fermentation, pursued in the first instance for its own sake, has come to have an economic importance which is simply incalculable.

American legislators have lent a willing ear to the advice of wise men. What we now enjoy we owe mainly to the counsels of Joseph Henry, Spencer F. Baird and G. Brown Goode. And I may call attention here to a thought which will be expanded presently, namely, that the secret of the success of these men is to be found in their enthusiasm, unselfishness and lofty scientific and personal character. When we consider the liberal appropriations made year after year for the United States Geological Survey, the nobly equipped station at Wood's Holl, the purely scientific work which is now being supported by many States and municipalities, there is abundant cause for congratulation; but lest we think of ourselves more highly than we ought to think, let us recall the contrast between our lavish liberality in certain appropriations and our lack of enlightenment in certain details of legislation. The student steps in line with the farmer to support the manufacturer; he is encouraged to work, he is denied the tools. In regard to the importation of models, microscopes and other scientific instruments the tariff is a tax which bears most heavily upon research. By the tariff on lithographic plates Congress places a Chinese wall around publications of the first class in all branches of natural history. America is a most unfavorable center of scientific publication so far as illustrations are concerned. Professor Sedgwick will perhaps have something to say upon these subjects.

In these matters the American Society of Naturalists has expressed and will continue to express its urgent desire for reforms which will come about through public enlightenment.

The main object of this discussion, however, is not merely a reiteration of opinions which we all share, but a symposium in regard to some of the new directions in which we must apply our energies in order to secure ultimately the best results.

In the last analysis we are *advocating public taxation* for the purposes of research. Having considered the parental relation of the State to the investigator—what are the filial relations of the investigator to the State. Granting that we have carried the outer works by demonstrating the wisdom of taxation, felicitating ourselves upon the fact that we have an enlightened public opinion behind us, there now remains the honorable obligation on our part of administering these funds to the very best service of the State, and it is to this obligation I wish to especially direct your attention. There are two directions in which it is possible that we have not as yet fulfilled our duty.

I believe with Huxley that good science rests upon good morals and that good morals rest upon those principles which are best enunciated for plain people in the ten commandments. In the special field of work under discussion, it seems to me that in return for the confidence of the State, specialists are under the binding obligation to administer public funds in the most scrupulous manner. I have in mind instances where the confidence of the State has been betrayed and where results damaging to the general cause of science have inevitably followed. Extravagance in the use of words and parsimony in the use of ideas; the lavish illustration of papers of little scientific and of less literary value; the reckless expenditure of public funds for instruments, apparatus,

and general equipment that anticipate imaginary rather than real needs; the diversion of these funds to purposes for which they were never intended; the surreptitious introduction of material not mentioned in the original purpose of an appropriation; in short, the obtaining of money under false pretenses; these are immoralities which retard the development and jeopardize the existence of the grand system which our state and national governments have so wisely instituted.

A second consideration is the importance of cooperation between nation, state, and university in education and organization for research. A conspicuous example of the splendid results which may flow from such cooperation is found in the present administration of the United States Geological Survey. We see the Government cooperating with the states and with the universities and public museums to produce a uniform investigation of the geology and paleontology of the entire area of the United States. Of this Professor Clark is far better qualified to speak than I am.

In the foundation of the United States Fish Commission Station at Wood's Holl, Spencer F. Baird, one of the most large-minded men this country has produced, formed a similar conception of the advantages of cooperation in biology, which alone justifies the erection of an enduring monument to his memory. While the execution of his purpose may be described as having ebbed and flowed like the tides, strong under some administrations, such as Goode's, and not even as yet fully attained, we have in the last few years seen an approach to the fulfilment of Baird's ideal, and it remains for the United States Fish Commissioner and his staff, and the Director and Trustees of the Marine Biological Laboratory at Wood's Holl, to consider a plan of cooperation which will effectively combine the intellectual and material forces of these two institutions in the future. No private institution can compete with the material resources of the government; no government institution can flourish without availing itself of the intellectual resources of the university. The cooperative advantages which the Marine Biological Laboratory should enjoy as the premier institution of its kind in this country should be extended to other laboratories along the coast. The difficulties in the way of bringing about such cooperation are more apparent than real, in fact, I am one of those who have firm faith that the ideal is also the practical and that we shall see Baird's plans fulfiled in the case of biology, even as Hayden's plans have been fulfiled in the case of geology.

If the larger scientific interests of the country are one, and if the Utopian state is one in which there is a sympathetic nervous system connecting state and university work, it is obvious that our colleges and universities should consider more carefully than they have done the preparation of men especially for state work. Educators have perhaps had too exclusively in mind the medical school, the teaching profession, and too little the direct service of the state. This is a feature of the general subject which will be especially spoken of by Dr. Howard who is well qualified by his knowledge to discuss present conditions in state and college and the present needs of government science.

College and university men of science, and state and government men of science, naturally acquire certain individual characteristics; they have their strong points and their weak points, and it is of advantage to American science at large that these two classes of men in all departments of science, in physics, chemistry, geology, botany, zoology, should abrade their angles by coming into frequent contact; because contact not only removes prejudices, but it increases mutual respect and admiration,

until an entire unity of purpose and action is consummated which completes the scientific structure of the nation.

HENRY FAIRFIELD OSBORN.
COLUMBIA UNIVERSITY.

THE attitude of the state toward scientific investigation is less a question of inherent right than of expediency. Political economy assigns no sharp limitations to the functions of government and whether or not any particular interest should receive the fostering care of the state depends upon circumstances. That scientific research is a subject of government concern is becoming recognized more fully every year. A well-known English educator in discussing the endowment of research by the state says: 'that liberal and scientific culture, intelligence, and the whole domain of mind, is a national interest, as much as agriculture, commerce, banking or water-supply.'

Granting all this, and I am sure no one here maintains any other view, we are confronted with the fact that the state cannot support, or even subsidize, *every* national interest. Which should receive government support must finally be determined by expediency—by whether in the long run the state is to be benefited by the aid extended.

Agriculture, commerce and banking, for example, can be maintained by private enterprise and can be made largely or wholly self-supporting. Their prosecution can be left therefore largely to the individual, with such incidental protection as may be required in the particular case. Scientific investigation is not and cannot hope to be self-supporting in most instances. This I believe to be the determining factor. Admitting the material value of scientific investigation to the state, it becomes necessary for the state to see that its interests are secured.

It may perhaps be desirable to examine for a moment the reason why scientific investigation is not and can not be self-supporting. This may be found in the fact that the great majority of scientific researches have no immediate commercial value and as commodities can not find a speedy or, in most instances probably, even a prospective market. We all know of many investigations, begun without thought of pecuniary advantage, that have ultimately produced practical results of the greatest importance. Instances might be cited of investigations, the value of which were not apparent until a generation or more had passed, as, for example, paleontological researches which have laid the foundation for the correlation of deposits of great economic value. The support of such investigations must, as Professor Osborn has shown, be looked upon as investments for the state which no far-sighted statesman will ignore.

I have found, although my own experience has been limited to be sure, that the average legislator, who is considering honestly the interests of the state, is not without appreciation of the far-reaching value of scientific work, if convinced that the investigations proposed will be honestly conducted. The legislator, surrounded, as he too frequently is, by evidences of political jobbery of every sort, is very keen in detecting what is false and untrue. He may be over-suspicious in some instances and may even suggest that you have some ax to grind in the measure which you bring forward, but if he is honest in purpose his support in the end is not difficult to obtain. I have always gone on the principle that the legislator whose support I was seeking was a public-spirited and intelligent citizen who was capable of judging of the true merits of the subject under consideration. I have never claimed for the investigation proposed that it would in every instance bring an immediate financial return, but rather that the work laid the foundation for subsequent re-

searches, the material value of which could not be estimated. In stating the objects of the Maryland Geological Survey in the opening chapter of the first volume of its reports I said: "The fact must be borne in mind that much preliminary and fundamental work has to be done, the utility of which is not at once apparent to the uninitiated. The publication of such material, rendered necessary as a basis for future investigation, is often liable to misinterpretation, but yet may be of far more lasting value to the State than some superficial statement that is intended to meet a supposed practical need." I believe it is not difficult for the scientific man, with a subject of real merit, to secure the confidence and support of any body of legislators, if he approaches them with honesty of purpose, and with his plan sufficiently matured for them to see its real significance.

We find that ever since the establishment of universities and seminaries widely over Europe in the fourteenth and fifteenth centuries, the civilized countries of the world have recognized in one form or another the relation of the state to scientific investigation. Not only the great nations of the world but oftentimes the small and relatively poor countries like Belgium and Switzerland, as well as the smallest of our own commonwealths, have frequently provided liberally for the support of scientific research. This has been accomplished through the publicly endowed educational institutions, through the public museums and through the special bureaus of the government. The dependence of these various public organizations, as well as the privately endowed institutions upon one another in scientific investigation, has been already pointed out by Professor Osborn, and I shall presently refer to a concrete instance of this in my own work.

Too frequently scientific investigation has held a subordinate place in both the publicly and privately endowed institutions, their chief functions being either educational or commercial. The purpose of the schools and universities is primarily in most instances the instructing of youth in the already acquired results of scientific research rather than the fostering of investigation for itself, although the latter as a secondary consideration often holds a prominent place in the larger institutions of learning. The museums and scientific bureaus are like our great universities centers of research, without the exactions of teaching, where continuous investigation can be pursued under most favorable conditions, although here again either educational or commercial considerations for the most part ostensibly control. That this is not always the case either in our own country or abroad is cause for congratulation, and the support of research directly for itself without other, and oftentimes false, claims is becoming yearly a more fully recognized fact.

It is interesting for us who are Americans to know that the claims of science received recognition at the very inception of our government, for we find that George Washington in his first message to Congress stated: "Nor am I less persuaded that you will agree with me in opinion that there is nothing more deserving your patronage than the promotion of science and literature. Knowledge in every country is the surest basis of public happiness. In one in which the measures of government receive their impressions so immediately from the sense of the community as ours it is proportionally essential." How well that early advice has been carried out by the statesmen of later days under the wise counsels of Henry, Baird, Goode and their successors, Professor Osborn has already shown.

That much can be accomplished through cooperation between our national bureaus and the State and university institutions, I

have had occasion to know in the conduct of the State Geological Survey of Maryland, the resources of several of the national bureaus, as well as the State and university institutions being at my disposal in the advancement of the work. Any single one of these agencies, if alone employed, could not readily have accomplished the same results. This is shown by the scope of the work which the local scientific bureau in most of our smaller States must necessarily embrace. Its investigations cannot be as fully differentiated as is possible in the case of the national bureaus, except by largely increased expenditure, seldom provided even by our richest States, and whether the organization is known as a geological survey or by some other name, it must naturally deal with the whole realm of the physical features of the commonwealth. It need not, however, encroach upon the functions of other departments of the government and more particularly of its nearest associates, the more strictly agricultural institutions, but should, by the classification and mapping of the soils which depend primarily on geological criteria, afford the foundation for agricultural work. But in this as well as in the topographic, hydrographic, magnetic, climatic and forestry work, the relations of all of which to geology are more or less intimate, the aid of the national bureaus is essential, while the State bureau can be the medium by which the results may be presented to the local communities in a manner that would be difficult if not impossible for any institution of the central government. Each has a well-defined field of action and instead of conflicting can be of material advantage to the other.

The same is true of the university and in even larger degree, for here are trained the specialists, who either in State or in national work can add much to the effectiveness of both, while the opportunities afforded by the latter for wider experience react on the university in many ways. The advantages offered the university instructor and student by cooperation in government explorations and surveys are only part of the increased opportunities which can result from this relationship. The various bureaus and divisions of the U. S. Department of Agriculture, the U. S. Geological Survey and the U. S. Coast and Geodetic Survey are all manifesting a broad spirit of helpfulness that is being met by the state and university institutions. The possibilities of an extension of this cooperation between nation, state and university promise well for the widening of the bounds of scientific investigation in this country. It is indeed a hopeful sign when we see the scientific men of the nation, whatever their affiliations, working together with mutual interest and respect. May it presage the dawn of a still brighter day in American science.

WM. BULLOCK CLARK.
JOHNS HOPKINS UNIVERSITY.

THE State and scientific research cover an enormous field—as broad as scientific research and as broad as government possibilities. The men who have spoken and are still to speak are specialists. They can speak theoretically of other matters, but more authoritatively of their own field. I am a specialist and shall therefore limit myself to 'the State and zoology.' By 'the State' I shall refer only to the general government.

In opening this discussion, Professor Osborn indicated two points upon which he expected me to speak. The one was the ultimate practical importance of pure scientific work from the standpoint of applied entomology, and the other was the preparation of men by our colleges and universities especially for State work. In regard to the first topic, the case is so self-evident as to require little elaboration. It is upon work in pure science that the entire superstruc-

ture of economic entomology has been built, and workers in applied science are constantly making use of the results of the labors of workers in pure science. The practical outcome, however, of the labors of the workers in pure science is indirect, while the practical outcome of those who work in the economic applications of science is direct. In any emergency the direct method is the one which is immediately productive of practical results. The study of economic entomology is a study of facts which will enable us to meet one great and widely extended emergency. It must be conducted by the direct method, and the reason why this country stands in advance of the rest of the world in this application of science is because we are a practical people and have adopted the direct method. There can be no doubt, however, that it is necessary for the most successful economic worker to have had a sound training in pure science.

This leads us naturally to the second point—the preparation of men by universities especially for State work. The first training should be, as just stated, a broad one in pure science, but the practical applications should follow with as rigid a course of instruction as can be given. University teachers should make a study of the markets for the brains and training of their students. They should study the conditions of those markets and their needs. This is self-evident. But where is there a college professor who has made a careful study of the practical scientific needs of the Government? Some years ago the President of Vassar College visited in Washington during the Easter vacation. He spent his days visiting the scientific branches of the Government service. He spent his evenings at the Cosmos Club talking with the heads of those bureaus. He went home and arranged a course of lectures on the scientific work of the Government to be delivered for the most part by the men actually at the head of these branches of work. His aim was simply one of broad education, and I doubt whether he had any practical point in mind for the future of his students beyond the acquisition of general knowledge, but you will readily see that this idea might be used in a most practical way.

Men in charge of university departments of scientific work should keep closely in touch with the Government work along similar lines. They should be encouraged to do this by the Government. Government should employ their services wherever they can be of use, and such cases are numerous. They themselves should be able, with the intimate knowledge acquired by official association or by close investigation of Government work, to lay out lines of study which will fit their students to take a hand in Government work. In many cases, of course, this cannot be thoroughly done in university laboratories at the present time. Very few college graduates can pass the special examinations for certain scientific positions under the Government without training which they have secured outside of the colleges. A study of such conditions will show just how this is to be done, and universities will find it to their advantage to increase their facilities for instruction in such directions, and certainly it will be to the advantage of the Government scientific work. This is by no means a new idea. Several practical college men have been asking this question of men in charge of Government bureaus and only recently the newly elected President of the Massachusetts Institute of Technology, who went there direct from a Government bureau, sent out a circular letter asking Government officials how he can best train men in Boston for other branches of Government scientific work than that of which he was in charge.

What does government do for zoology,

and what ought it to do? If it does not do as it ought, why does it not do so?

Aside from the meager sums which the State experiment stations supported by the Government allot to animal industry and to economic entomology, the zoological activities of this Government center at Washington. There are three institutions which do zoological work for the government. The Smithsonian Institution, with its National Museum and National Zoological Park branches, is the only one of the three which cares for pure zoological science. The U. S. Department of Agriculture, with its Bureau of Animal Industry, its Biological Survey, and its entomological service, is wholly economic in the aims of its zoological scientific work. The third of these institutions, the U. S. Commission of Fish and Fisheries, was also established by the Government for a purely economic purpose.

It is not my intention to dwell at any length upon the relative merits of economic and pure scientific work. I have a strong conviction that humanity gains far more from scientific work undertaken with an economic aim than from the labors of the other class of scientific men, and I believe it to be a most unfortunate condition of affairs that hundreds of the men, best fitted by brains and training to attack the many economic problems which are fairly crying for solution, are delving away in their search for truths and principles which when found have only a remote bearing, if any at all, upon the sum total of human happiness. I was once filled with the resounding majesty of the phrase 'science for science's sake,' but now, while I admit the grandeur of the idea, I have come to parallel it and its opposite in my mind with the contrast between abstract and practical Christianity—both beautiful, but one for gods and the other for men.

Now what is Government doing for these three scientific institutions at Washington?

The Smithsonian Institution receives each year $246,540, for the National Museum, and $75,000, for the National Zoological Park. The National Museum employs 33 scientific men, and the National Zoological Park, 2. All are pitifully underpaid. The amounts spent on purchase of collections have been extremely small. Neither the Museum nor the Park has a responsible head in the proper sense of the term. The Secretary of the Smithsonian Institution supervises the work of both branches and alone asks Congress for their appropriations. The personnel of the scientific force of the Museum is admirable in quality but absurdly insufficient in quantity. Not a scientific man on the force has the proper facilities for work. The collections are large but they are one-sided and there is little money to supply the deficiency. Underpaid, with few facilities, grievously dissatisfied with conditions, nothing but the rare enthusiasm which scientific work inspires keeps these able men at their labors. The National Museum needs a new building planned for all time to come. It needs now an annual appropriation of double the present size. As soon as the beginning of a new building is made it will need an appropriation of ten times its present size. Think of what the words *United States National Museum* should mean and then think how the present institution fits the name! Government has not given a proper amount of money and Government shows faint signs of ever giving it. Why? Because Congress has not been made to see the importance of the subject; because Congress has not been asked for the money with sufficient force and with sufficient argument. The Board of Regents of the Smithsonian Institution might make this request and back it with all the weight of the illustrious names of the men who compose that body. The Secretary of the Smithsonian Institution

might make this request and urge it strenuously and incessantly and with an ability which few other men possess. The scientific men of the country might urge it. Organizations of many different characters might petition Congress for it. But the men who best know the truth about the present conditions, the scientific employees of the National Museum, may say no word.

The National Zoological Park is naturally by no means as important an institution as the National Museum, since it is concerned with but one branch of science, but it falls as far short of what it should be as does the National Museum, and for the same reasons. Double the means and a force of zoologists are its important needs. This institution should naturally be a branch of the National Museum, but the National Museum as it should be and as it will be is too great a branch of Government to be controlled by the Smithsonian Institution. It should have its independent organization; it should have its responsible director who will spend his winter days laboring with Congress for appropriations and his nights planning broad lines of development. The Smithsonian Institution has done a great and good work, but it should not be given control of great national institutions like the ideal national museum. Infinitely better would it be were the Smithsonian Institution attached to the National Museum as one of its component parts. The Smithsonian has played its rôle with the Museum. It officiated at its birth and nursed it through its childhood; but the youth is now cramped. It must grow. It must burst the Smithsonian cage and stretch out its own appealing hands directly to Congress.

The U. S. Department of Agriculture is the first of the Government bureaus which does economic zoological work. Here as in the National Museum the men are underpaid, but the facilities for work are vastly better. Government appreciates more readily work which promises immediate economic results and hence money for such work is more easily gained. Scientific men in the Department of Agriculture refuse positions offered elsewhere at higher salaries, on account of these better facilities. Good research work and initiative in investigation are encouraged. Nothing could be more ideally perfect than the relation between the present head of the Department of Agriculture and his scientific corps. Four years ago he announced his policy in this regard in conversation with one of his scientific chiefs in the following words: "I am here to facilitate your work, not to dictate to you. Make your plans, conduct your investigations, and I will help you with all my strength, but I shall hold you responsible for results." Scientific men should honor James Wilson for the introduction of this novel principle in the administration of a Government scientific bureau. The good, sound, progressive scientific work now being done by his corps is everywhere commended, and I am proud to be connected with such an organization. New laboratory buildings are needed here, but there is no fear that they will not come in the immediate future.

The U. S. Commission of Fish and Fisheries deals with a single aspect of zoology and with a single industry. Just why scientific men are chosen as the administrative heads of the U. S. Geological Survey and the U. S. Coast and Geodetic Survey and not, since the days of Baird, for the Fish Commission is one of the mysteries of Government. Nearly four years ago this Society did the creditable thing in passing resolutions and sending them to Washington in the hands of Professor Osborn, protesting against the appointment of any other than a scientific man as the director of this important branch of applied scientific work. The present incumbent of the

office is a good official and no personal objections are to be raised against him. The principle, however, is not a good one, and the next appointee to this office should be a man who combines scientific attainments with administrative ability. The old popular idea of a scientific man—that he lacks what is called 'common sense,' that he is impractical—is an unfortunate estimate gained from unappreciative observation of workers in pure science, but it no longer holds. Henry, Agassiz, Baird—all men of affairs, now gone, did much to change this popular estimate, and the host of brilliant men who have succeeded them—men of high scientific rank, who control the destinies and shape the policies of great institutions, and who turn out work of great and important practical value, have demonstrated beyond the slightest doubt that scientific men are the broadest men of affairs, that they are practical men, and that they are fit to be leaders not only in thought but in action.

It is doubtful whether any government in existence does as much for the encouragement and development of science as does our own. This has repaid her a thousand fold, and the sound judgment of the American people and their patriotic pride in national attainment will effect a steady increase in governmental support of scientific work in spite of temporary checks. With scientific men, however, must come the initiative. They must point out the needs and the ways and means by which these needs must be supplied. This fact is the justification of this discussion.

L. O. HOWARD.
U. S. DEPARTMENT OF AGRICULTURE.

Is it not true that the attitude of the State toward science and scientific research is at all times greatly influenced by the shaping of public sentiment through the work of scientific men themselves? This is a practical age, and in America especially the tendency is more and more to give a practical trend to almost every line of research. We find, therefore, as a matter of fact, that there is a general lack of interest in, and support of, matters having to do with pure science alone, while on the other hand all questions having practical application, and even those in which the practical end is remote are received with commendable liberality. Taking the field of botany, for example, it would be difficult, if not impracticable, to secure support for the preparation and publication of purely floristic monographs, unless it could be pretty clearly shown that such a project had some practical end in view.

In so far, therefore, as the attitude of the State toward all work of this nature is concerned, there is a great deal of conservatism to be overcome, and this conservatism is especially pronounced where pure science is brought strongly to the front. The reason for this is not far to seek, for its roots lie imbedded in the selfishness of human nature, which, acting through organization in the shape of government, sees, or thinks it sees, in the aggressiveness of science a menace to existing institutions in some form or other. While science in its nature is aggressive, the men who do most to advance it often lack aggressiveness, and for this reason the far-reaching effect of science as an educational factor at the present time is not fully understood or appreciated.

This brings me more particularly to the main question I wish to raise in this discussion, namely, what should be the attitude of the scientific man toward the cause he represents. I am strongly of the opinion that he owes it to himself and to his work to put forth every legitimate effort to advance the interests of the cause. He should of course keep constantly before him the fact that to bring honor and credit to the

work he must recognize the duties of life which Professor Osborn has already pointed out. This will not allow him, however, to sit calmly down and wait for the material things of the world to come to him. The men who have it in their power to aid him are too busy to go out of their way to render help unless that help is sought. There exists a mistaken idea that because one is engaged in or may be directing scientific work he is the one to be sought. We see this idea shaping the policy followed in some of our important institutions, as already pointed out by Dr. Howard, and as a result they are being outstripped in every way by others which have a better appreciation of what is necessary to influence public sentiment. After all, the public and those who represent the public look at this matter in its true light, for they have been educated to expect those who are responsible for important lines of work to make their needs plainly understood.

With the distinctly utilitarian sentiment toward science, as pointed out, the question arises as to what stand should be taken by those charged with the guidance of the work with respect to shaping a general policy which will meet the demand for practical ends, and at the same time advance the cause of science to the fullest extent. Extremes must be avoided, for if the tendency is too strong toward pure science, opportunities will be lost through lack of support, and if toward ultra-utilitarianism, science itself will he endangered through the development of false views, erroneous statements and lack of judgment—rocks and reefs that must by all means be avoided. There is always a medium ground, however, where science and practice can each be made to help the other and each be the stronger for the support thus gained. This is the stand, I may say, that is now taken by those charged with most of the work conducted under the auspices of the Government, and which, during the past fifteen years at least, has resulted in a rapid development of all work along broad and safe lines. Most of the departments of the Government, wherein scientific work is carried on, owe their existence to a demand for greater knowledge on problems concerning the interests and welfare of the people. In the early days of this work too much attention was given to a mere diffusion of knowledge without regard to its source, and as a result of this original research did not receive the attention it deserved. In later years, however, the importance of research is becoming more and more appreciated, and as a result the work has increased in strength and now commands the respect it deserves. It is unnecessary to dwell upon any specific work now being done by the Government, as the object of this discussion, as I understand it, is more to deal with general matters, and certain of the details have already been given by Dr. Howard. I will conclude what I have to say with just one statement, namely, that the future attitude of the State toward scientific research will in large measure depend on our own efforts individually and collectively. Let us therefore go forth with a determination to advance the cause of science in every way and to stand firmly for the great principles of truth it represents.

B. T. Galloway.
U. S. Department of Agriculture.

In considering the attitude of the State toward scientific investigation it may be well to remember that with us the State is the people, ours being a government of the people, by the people, for the people. What then is and what should be the attitude of the people toward scientific investigation? Probably very much the same as their attitude toward education, and concerning this there can be no question. From the very beginning our people made careful provision for education by the establishment of public

schools. They have asked, and answered emphatically in the affirmative, the question: Does education pay; and I believe that they are asking and answering the other question, Does scientific investigation pay, very much in the same fashion. The golden stream of benefactions which has now for many years been flowing in upon educational establishments proves that the people firmly believe that education pays. They believe in education.

I have been very much interested to hear the quotation from the 'Message of Washington' urging upon our people the importance of promoting scientific investigation and research. I believe that the American people are, in increasing numbers, large-minded enough to look through and beyond the nearer every-day phenomena and to realize that the promotion of discovery, no less than the promotion of learning, pays in every sense of the word. They perceive that it pays in the highest sense, in the enrichment of intellect and the cultivation of faculty. They perceive also that it pays in the utilitarian sense, in that it gives leadership among the nations of the earth in the applications of science which always follow hard upon the heels of discovery. Professor Osborn has done well to point out that those nations which support research most liberally are those which are taking the lead in the industrial world to-day.

I remember a saying of General Walker's, that he firmly believed that we should outgrow the necessity of protection, and we are beginning to-day to witness the fulfilment of his prediction. The enormous development of our export trade, based upon our scientific and economic system of manufactures, arts and industries, marks that over-growth of the merely home market and local protection which General Walker was far-sighted enough to foresee. I believe that, if once the people realize what a burden and a hindrance is inflicted upon scientific research, and thereby upon educational and industrial progress, by the tariff upon microscopes, dissecting instruments, models, diagrams and other apparatus of research and instruction, that tariff will melt away like dew before the sun.

And so it is also, I believe, with the relations between pure and applied science. The barrier between them is fading away, because they are constantly drawing nearer together and over-growing one another. Pure science has given to applied science the fundamental elements of truth, perfection, knowledge and skill. Applied science, on the other hand, has developed so prodigiously as to react favorably upon pure science, furnishing for it rich sustenance and fertile soil in which it may flourish. An hour might well be spent in pointing out not only the aid which pure science has given to applied science, but reciprocally the enormous development of pure science and scientific investigation wrought by applied science. It is one of the marvels of the day that many highly organized and differentiated industries, and even many of the coarser arts, find their narrow but sufficient basis of profit in the employment of the results of latest and most advanced researches in pure science.

Our age has been called by one of the speakers who has preceded me, a practical age, and so it is; but it is an age which has discovered in science the Promethean fire. The highest and truest utilitarianism of to-day is a generous cultivation of scientific investigation, not indeed for its own sake, but for the sake of the results which are sure to follow from it. As to the pursuit of science for its own sake, Professor Osborn has, it seems to me, used a happy illustration in referring to the scientific investigations of the Government as an investment rather than an immediate outlay for current expenses. As to pure science pursued strictly for its own sake, I think we may

rather describe it as an investment from which we still expect ultimately some return. Science for its own sake is, after all, much like investment for its own sake; which has never been made, I fancy, even by the least practical of philanthropists.

For illustration of public appreciation of scientific research as a necessity for practical results, I may give an example. When in 1886 the newly organized State Board of Health of Massachusetts attacked scientifically the problem of protection of the purity of inland waters, they reported to the people of that State that in order to do the work required by the Legislature it would be necessary to inaugurate and prosecute special and novel investigations, and for this and other purposes they asked for an appropriation of $30,000. This sum was immediately and cheerfully granted by the people for this purpose and has ever since been continued, annually, with the result that the Massachusetts experiments are referred to with commendation and advantage by bacteriologists and engineers all over the world. Again, when it became clear that antitoxin for diphtheria had become a public necessity and its proper preparation a public duty, the same State Board of Health secured the services of one of the most distinguished bacteriologists in the country, Professor Theobald Smith, and requested him not only to prepare antitoxin for the citizens of the State, but also to investigate the best methods of its preparation and preservation, besides other cognate and novel but pressing problems in the field of pure science. Here also the most thorough-going utilitarianism has proved to be scientific investigation pushed to its utmost limits.

Just here also the State, by and for the people, might well do much more than is yet done. As a nation we have hitherto played but an insignificant part in those scientific inquiries which underlie the medical and sanitary arts. As a nation we cannot claim any of the credit for originating the germ theory, or antiseptic surgery, or for laying the foundations of modern bacteriology, or for the discovery of antitoxins or for elucidating the ætiology of malaria, or for inventing the agglutination test for typhoid fever. We may be excused for our inertness previous to 1870, because until then the civil war or its sequelæ claimed all our energies; but from comparative inactivity in these matters since that time—excepting in one honorable division of the government service, the agricultural,—we have no good excuse to offer. If we are to hold our proper place among the nations in the prosecution of medical and sanitary inquiry the State or the States must lend their powerful aid, or else private enterprise or the universities must do far more than they have yet done in this direction.

In this connection, and especially on this platform, it will not be out of place for me to refer to the intense satisfaction which all lovers of good government and of the intelligent and scientific administration of public affairs feel, that Dr. Gilman, the founder of purely university education in America, and the president of this University, which has done so much for the cause of scientific investigation, has consented to accept the presidency of the National Civil Service Reform Association; for I believe that the introduction of more science and more scientific investigation into the civil service means the development and extension of a rational system of government based upon merit, rather than partisanship or spoils. Here Harvey, the father of physiology, raised the true standard for us when he exclaimed: 'I avow myself the partisan of truth alone.'

I cannot close without expressing my cordial assent to another point made by Professor Osborn and my belief in its extreme importance, viz., the reciprocal duty which the scientific worker owes to the State.

Who can forget the famous and stinging characterization of that tutor in Magdalen College whom Gibbon's caustic pen has embalmed in eternal disgrace, one Dr. ———, of whom Gibbon said, 'he well remembered that he had a salary to receive, and he only forgot that he had a duty to perform.' I have always been sorry that Dr. ——— was a teacher and glad that he was not a scientific man. President Hadley, I think, struck the right note when he cautioned young men not to ask themselves 'How much can we get out of college?' but rather, 'How much of ourselves can we put into it?' Science, like religion, demands of her votaries lofty sacrifices and personal devotion, and if they are public servants their debt to her is always not less but more.

WM. T. SEDGWICK.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THE ALBANY MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

I.

THE thirteenth annual meeting of the Geological Society of America was held in Albany on December 27, 28 and 29, 1900. The fellows were called to order by the retiring President, Dr. George M. Dawson, Director of the Geological Survey of Canada, at 10 A.M. on Thursday, in the chapel of the Albany Academy. A very gratifying number of members was present and during the sessions from 50 to 60 were in attendance. All felt the significance of meeting in the city where stratigraphical geology received its greatest single impetus in America and where the classification of most of the Paleozoic was chiefly worked out. Memories of James Hall were in all minds and frequent reference was made to the late venerable State Geologist, first President of the Society.

At the opening meeting brief addresses of welcome were made by Dr. F. J. H. Merrill, State Geologist, and by Dr. J. M. Clarke, State Paleontologist. The Council then presented its written report, which showed the Society to be in a very flourishing condition. During the year one fellow, Mr. Franklin Platt, has died. The present enrolment is 248, and the financial condition is gratifying. The following officers were declared elected:

President, Charles D. Walcott, Washington, D. C.; *First Vice-President*, N. H. Winchell, Minneapolis, Minn.; *Second Vice-President*, S. F. Emmons, Washington, D. C.; *Secretary*, H. L. Fairchild, Rochester, N. Y.; *Treasurer*, I. C. White, Morgantown, W. Va.; *Editor*, J. Stanley Brown, Washington, D. C.; *Librarian*, H. P. Cushing, Cleveland, O.; *Councillors:* Samuel Calvin, Iowa City, Ia.; A. P. Coleman, Toronto, Can.

A memorial of Franklin Platt, prepared by Persifor Frazer was then read by W. M. Davis, and at its conclusion the reading of scientific papers was immediately taken up.

Experimental Work on the Flow of Rocks recently carried out at the MacGill University, Montreal: FRANK D. ADAMS.

This paper gave the results of an investigation in which the effects of very heavy pressure on rocks were studied with a view to ascertaining how the gigantic movements which geologists observe in the strata of the earth's crust have taken place.

Marble was the rock on which most of the work was carried out, but harder rocks such as granite are now being studied as well. Small columns of marble an inch in diameter and an inch and one-half high were carefully turned, polished and then very accurately fitted into heavy wrought iron tubes constructed on the plan of heavy ordnance, by wrapping strips of wrought iron around a core of soft iron and welding the whole together. The core of iron was then bored out and the marble substituted for it. Heavy steel pistons were fitted into each end of the tube, and the rock was thus submitted to very high pressures, often for several months continuously, in espe-

cially constructed machines capable of developing pressures reaching nearly 100 tons to the square inch.

Under high pressures the marble was found to flow, bulging out the iron tube that enclosed it on all sides. When the iron tube was cut away a solid block of marble was obtained, which had completely altered its shape. It was found, however, that the marble in these cases was only about half as strong as the original rock.

Other columns of marble were then heated to temperatures of 300 C. and 400 C. and while thus heated the pressure was applied as before. Under these conditions the rock was found to flow readily and to retain its strength much better, being nearly as strong as the original rock.

In the third series of experiments the marble was not only heated to the temperatures before mentioned, but at the same time water under a pressure of 460 pounds to the square inch was forced through it while it was being compressed. Under these conditions, the marble after being molded was found to be as strong as it was originally.

A microscopical study of the structure of the deformed marble shows that in these two latter cases the crystalline grains composing the marble had glided on one another.

This structure is exactly the same as that which is produced in a billet of iron when it is heated and then hammered or rolled, or in a button of gold when flattened in a vise, so that the marble *flows* just as any metal does when submitted to pressure, except that under the ordinary conditions at the surface of the earth the brittleness of the marble causes it to break before the flow point is reached. In the depths of the earth, however, being hemmed in by other rocks, it flows as in the experiments.

The paper was elaborately illustrated by specimens and by many lantern slides, showing the machines employed, as well as the marble before and after compression. They also illustrated its structure as compared with that of various rocks found in the earth's crust and with hammered iron.

In discussion B. K. Emerson asked (1) whether the cylinders of marble contained any water before they were put into the machine; (2) if any schistosity resulted, and, if so, in what way it was related to the optical properties of the calcite grains; (3) if the marble rebounded on the release of pressure.

J. E. Wolff inquired whether the water that was forced in passed around or through the cylinder of stone, and if solution played any part.

G. K. Gilbert asked if the speaker could draw a parallel between the pressures employed and the depths within the earth corresponding to them.

In reply Professor Adams stated (1) that the cylinders of marble were kept in a perfectly dry laboratory, and that while no determinations of their content of water had been made, they were practically dry when put in the machine; (2) he had noted no rebound. The marble was first compressed and then accommodated itself to the pressure by flowage; (3) he had been unable to note any effects of solution as a result of the entrance of the water. The results were the same with or without the water, except that with the water the resulting disk was stronger. The water entered at the top under 460 pounds' pressure to the square inch and emerged at the bottom. The water had dissolved a little copper from the tube of entry, which was precipitated on the bottom of the marble. He could not state positively whether it went through or around, but the marble was in a bath of vapor.

J. E. Wolff suggested that waters with some dissolved dye or easily reducible salt be employed so that the last point could be

determined, and that ordinary limestone be compressed to see if it would yield marble, and that impure varieties be also used so as if possible to produce the silicates familiar as a result of metamorphism. G. K. Gilbert estimated approximately the depth which corresponded to the pressures employed. Roughly one vertical foot of rock corresponds to an increase of one pound per square inch, or one-half ton per 1,000 feet. Forty tons would therefore correspond to 80,000 feet or about 16 miles. This should be reduced somewhat, as rock is slightly heavier than the assumption, but the difference is slight.

C. D. Walcott remarked the deformation which he had observed in the rocks of the ranges in California and western Nevada, and emphasized the different behavior of brittle rocks and tough rocks, illustrating his remarks by photographs. The brittle rocks break while the tough rocks flow—the former being often driven into the latter. He suggested that Dr. Adams experiment with cylinders of varied tenacity.

G. K. Gilbert raised the point that rocks may compress slightly while they are within the elastic limit, *i. e.*, before they yield, flow or otherwise deform. He suggested the importance of determining the amount of this.

B. K. Emerson remarked the importance of allowing for the phenomena of recrystallization in interpreting the results.

Dr. Adams then thanked his colleagues for the suggestions, and stated his intention of carrying them into effect as far as possible.

The paper was felt by all to be one of the most important ever presented to the Society, and the investigations are of such significance that further results will be eagerly looked for.

Geomorphogeny of the Klamath Mountains: J. S. DILLER, Washington, D. C.

During the Neocene the Klamath mountain region of northwestern California and southwestern Oregon, by long-continued erosion, was reduced to a peneplain and the resulting marine sediments, rich in fossils and deposited along the ocean border, recorded its age. The Neocene strata were compressed and tilted, and with the Klamath peneplain and monadnocks were uplifted somewhat differentially several hundred feet above its former level. The invigorated streams in the rather long succeeding epoch of stability cut wide valleys across the peneplain to the coast, where extensive wave-cut terraces were developed. A much greater differential uplift followed, and elevated the region to an altitude of 1,200 feet to 2,000 feet, for the Klamath peneplain near the coast of 7,000 feet, and near the crest of the range causing the streams to cut deep canyons before the close of the glacial period. Near the northern border of the Klamath Mountains on the coast there has been a recent subsidence converting the lower courses of the rivers to tidal inlets.

M. R. Campbell inquired if the peneplain topography could be traced all around the mountains. The speaker replied that, while it was not everywhere present, it could often be recognized. Mr. Campbell then remarked the interesting parallelism with the Appalachians, the similar shading of plains into each other and the similar interpretation of escarpments.

As Mr. Diller had referred to great numbers of small lakes upon the elevated plain and with local 'fluviatile' rather than 'lacustrine' sedimentation, W. M. Davis suggested for the phenomena Penck's term of 'continental' sedimentation. He compared the region to the central plateau of France, and urged that under compression surface plains would warp in a general way like single strata, so that in a principal ascent of a large order there would be alternate ascents and descents of a smaller order of magnitude.

President Dawson referred to the Eocene peneplain of British Columbia that was protected from the sea during its formation by an intervening range of mountains, and was therefore subaërial in its character. He asked why the Klamath peneplain might not be explained by marine denudation. Mr. Miller replied that in the Klamath case Eocene strata were themselves trenched, and, therefore, the leveling was later; and that the entire absence of marine sediments compelled him to infer sub-aërial agencies. G. O. Smith spoke of the peneplain of Washington that lies between the Klamath mountains and British Columbia. It is post-Miocene, as it cuts Miocene strata, which have themselves been deformed, probably in the case of basalt by slipping along multitudes of joints, as suggested by Bailey Willis. G. K. Gilbert described the great Alaska peneplain, which slopes upward and eastward from the Alexander Archipelago to heights of 5,000 feet and more in the mountains. It has been vividly brought out by the photographs of the Survey of the International Boundary. He also remarked the parallelism that existed between the Pacific and Atlantic physiography. President Dawson cited mountains of the Pacific coast 7,000 feet high that have been sculptured out of uplifted plains. He sounded a note of caution, however, lest the observer be misled into believing in peneplains which had no real existence. Above a certain level degradation is abnormally active and rapid, and from this alone mountains may reach a common and deceptive level and yet not be stumps of peneplains. Mr. Gilbert, however, replied that his Alaska mountains were shouldered and therefore not open to doubt.

Origin and Structure of the Basin Ranges: J. E. Spurr, Washington, D. C.

The structure of most of the ranges which have been hitherto studied in the Great Basin region was first examined in detail, and in each case deductions were made as to the relative importance of erosion and of direct deformation, by either fault or folds, in determining the present topographic relief. Finally a general statement as to the origin of this relief is arrived at. The history of erosion in the region, and that of deformation, so far as these are known, were discussed separately; and the history and foundation of the fault hypothesis as applied to these ranges were examined. The conclusion arrived at is that the ranges in general owe their existence to the long-continued erosion of rocks folded and faulted by many successive movements, and that it is only exceptional that the folds or faults are expressed in direct deformation of the present surface.

This paper was read in abstract by C. D. Walcott and was illustrated by cross-sections. It involved a great amount of detail, however, which it is not possible to summarize, but which will be extremely valuable as a matter of record. At its conclusion the morning session adjourned. On reassembling the first paper read was the following:

The Tuff Cone at Diamond Head: C. H. Hitchcock, Hanover, N. H.

This cone is one of the famous ones of the Hawaiian Islands, and is interesting and exceptional in that coral, limestone and marine shells are copiously mingled with the tuffs, giving rise to a difference of opinion as to whether the cone is submarine and therefore marks a notable subsequent elevation of the land, or whether the organic remains have been ejected to their present positions along with the tuffs. No discussion followed, as the Fellows seemed too unfamiliar with the locality to hazard an opinion.

An Hypothesis to account for the Extra-Glacial, Abandoned Valleys of the Ohio Basin: Marius R. Campbell, Washington, D. C.

The lower courses of the Allegheny, Monongahela, Kanawha, Guyandot, Big Sandy and Kentucky rivers are characterized by abandoned channels which generally range from 100 to 200 feet above the present streams. Generally these channels are deeply covered with silt, but sometimes the rock floor is only partially obscured by a thin layer of sand and gravel. The streams which have forsaken these valleys have sought new routes, along which they have carved deep channels through the upland topography. Teays Valley in West Virginia is perhaps the most noted example, but the old channels at Carmichael and Masontown on the Monongahela River and at Parker on the Allegheny River are also well known.

No reason has been assigned for the abandonment of these channels; they can not be considered as 'ox-bows,' and they are all beyond the limit of glacial ice. The present hypothesis seeks to explain them through the breaking up of river ice and the formation of local ice dams, which were of sufficient height to force the water over the lowest divide in the rim of the basin and which persisted long enough for the stream to intrench itself in its new position.

The paper was illustrated by many lantern slides of topographical maps. It brought on an extended discussion, because the Fellows were generally familiar with the subject, since for many years Teays Valley has not been omitted at a meeting, but has come up in one connection or another, and has grown to be a sort of geological Banquo's ghost, that will not down. I. C. White opposed the ice jams and argued in favor of one large dam produced by the continental glacier when it crossed the Ohio river. He emphasized the softness of the rocks at the headwaters of the southern tributaries and the harder ones further down. W. M. Davis suggested lakes as a possible obstruction which had developed cut-offs by gradually falling waters. G. K. Gilbert opposed the explanation by means of a glacial dam, and suggested a possible change in climate, with increasing cold and a filling of the valleys with ice, which brought about a rearrangement of the drainage. M. R. Campbell opposed the explanation by lakes and by a glacial dam, because of the lack of uniformity in the sedimentation which should appear with such an extended cause. A. P. Brigham called attention to the fact that the new courses assumed by some of the rivers were longer than the old and raised the point that ice jams ought to cut off and shorten meanders. M. R. Campbell admitted the slightly longer courses in a few cases, but still supported the ice jam as against all the other causes suggested.

The Alleged Parker Channel: EDWARD H. WILLIAMS, Jr., Bethlehem, Pa.

The paper was a brief one, which described one of the cases cited by Mr. Campbell, located at Parker, Pa. Instead of an old channel, the apparently abandoned detour of the Allegheny river was explained by the disappearance or effacement of the divide between the headwaters of two tributary streams.

This general subject having been so well gone over, the above paper was not specially discussed.

Apparent Unconformities during Periods of Continuous Sedimentation: GEORGE B. SHATTUCK, Baltimore, Md.

The paper was based on certain phenomena which the author had observed along the shores of Chesapeake Bay. Lenticular beds of black clay were found resting with apparent unconformity on older sediments and provided with cypress knees and other fossilized vegetation. The explanation advanced was that minor stream valleys had been ponded during subsidence of the shore by bars formed across their mouths. Thus, while the sea crept inland and formed extended sediments, these ponded embay-

ments would be the place for the gathering of clays and vegetation which would lie unconformably with the synchronous shore deposits. The paper was very clearly presented and was suitably illustrated by the lantern.

Origin and Age of an Adirondack Augite Syenite: H. P. Cushing, Cleveland, Ohio.

Recent work in the field, together with chemical analyses, demonstrates that the Adirondack anorthosite shows a certain amount of differentiation and passes locally into an augite syenite, all intermediate phases being found, as was contended by the writer in a paper read before the Society two years ago. There is, however, much evidence now at hand to show that much of the great body of augite syenite gneiss in the Adirondacks is older and to be referred in age to the main body of gneiss of the region, whatever that may be. Criteria for distinguishing between the two syenites have not been developed. The paper was presented by permission of the State Geologist, and was illustrated by an extensive series of analyses. J. F. Kemp remarked the abundance of related rocks in the regions to the south, and then the session adjourned for the day.

In the evening the annual dinner was held, with Professor Emerson in the chair and fifty-five present. An address of welcome to the Society was made on behalf of the Regents of the University by Dr. T. Guilford Smith. The proposition for the erection of a State museum in which to house the collections of the various scientific departments was discussed, and resulted in a subsequent resolution which will be given below.

On Friday morning the Society met at 9:30 and listened to a report of the Committee on Photographs by its chairman, N. H. Darton. The collection now numbers over 2,000, and is stored in the building of the U. S. Geological Survey in Washington. It is a valuable one, and will be revised and condensed, and a published list will be prepared at an early date. This collection has made accessible to the Fellows many photographs made by surveys, both State and national, and by private individuals.

The Laurentian Limestones of Baffinland: Robert Bell, Ottawa, Canada.

The discovery of great quantities of crystalline limestones in Baffinland was announced in the writer's 'Summary Report for 1897.' The geographical position and physical aspect of the region were described. The general character of the Laurentian System in Hudson Straits was outlined. The rocks of the north side are newer or Upper Laurentian, as far as known, and differ from those of the south shore. Regularity of strike and dip is pronounced. Enormous developments of crystalline limestones have been met in southern Baffinland. Their general characters were described. Great thickness is presented by the beds, some of them being over a mile across and running regularly for long distances. They are evidently stratified aqueous deposits. Questions were raised as to the origin of such limestones. The associated rocks are gneisses and schists, and the accompanying minerals are chiefly feldspar. Owing to the absence of trees, the limestones are conspicuous in the landscape and are not more eroded than the gneisses. Comparisons were drawn with Laurentian limestones elsewhere, the former physical conditions and the older and newer glaciations of Baffinland were discussed as affecting the limestones. The existing glaciers there were described. The paper was illustrated by the lantern. There was no discussion.

James F. Kemp.

(*To be concluded.*)

THE AMERICAN PHYSICAL SOCIETY.

THE American Physical Society held its annual meeting at Columbia University on Thursday, December 27, 1900. The following officers were elected for the year 1901: President, H. A. Rowland; Vice-President, A. A. Michelson; Secretary, Ernest Merritt; Treasurer, W. Hallock; Councillors, Henry Crew and E. B. Rosa.

Professor M. I. Pupin, in a paper on anomalous propagation of electrical waves, called attention to certain peculiar results which he had obtained when trying to improve the telephone transmission of a line, by counteracting its capacity by the introduction of self-induction coils between the outgoing line and the return. By this means he was able to considerably improve the transmission of certain frequencies, but he had not succeeded in reenforcing a sufficient range of frequencies to avoid a serious distortion of the quality of articulate speech.

The discussion by Professors Rowland and Webster and others raised the question as to whether Professor Pupin's abnormal velocity of transmission, considerably above that of light, derived from the relation that velocity is equal to the wave-length divided by the period, is justifiable, since it is doubtful what is to be called the 'wave-length' in a coil.

President Rowland reported that his search for an electromotive force due to dragging a wire through the ether had so far failed, and that it would appear that so far as the limits which he had used were concerned, it was safe to conclude that no positive results are attainable.

In a theoretical consideration of certain magneto-optical phenomena President Rowland pointed out that by considering each of two particles as having quantitatively different charges of electricity, he had been able to deduce formulæ which account for many of the electro-optical effects, as the Zeeman, Faraday and other effects, as well as refraction, double refraction, dispersion, dispersion in double refraction and absorption. If the charge of one of the particles is practically infinite as compared with the other, then his formulæ reduce to the ordinary ones. If the two charges are equal, no Zeeman effect could take place.

Professor E. F. Nichols presented the results of his investigations upon the energy radiated from certain stars and planets as measured with his radiometer, which proves to be about thirty times as sensitive as the radiomicrometer of Professor Boys. The unit used to express the quantity of energy was the hundred-millionth part of the energy received from a candle at a distance of one meter, *i. e.*, 10^{-8} meter-candle. The results obtained were as follows:—Vega, 0.51,—Arcturus, 1.14,—Jupiter, 2.38,—and Saturn, 0.37.

Two papers by Professor R. W. Wood were read by the Secretary. In the first he outlined the method of making very efficient cyanine prisms and of showing their anomalous dispersion. In the second he called attention to certain peculiarities in the propagation of waves reflected in a spherical mirror.

A brief *résumé* of the work of the Paris Congress of Physics was given by Professor A. W. Webster. The reports of the congress have appeared in three volumes, and a 'Proces Verbaux.' It is of general interest that this congress by its commission on units expressed the belief that it is desirable:

1. That a unit of pressure be used, called the *bary*, which is the C.G.S. unit (that is a dyne per square centimeter). The *megabary*, equal to 10^6 C.G.S. units, may, for practical purposes, be considered equal to the pressure of a column of mercury 75 cm. high at 0°.C. under normal conditions of gravity.

2. That the *final* results of calorimetric experiments be expressed in the C.G.S. mechanical units (erg and joule).

3. That in the logarithmic subdivision of the spectrum the sections be called 'regions.' The visible region to include the part between 0.4 μ and 0.8 μ and bear the index 0, the infra-red regions having positive, and the ultra-violet, negative indices (thus, R_2 from 3.2 μ to 1.6 μ, R_1 from 1.6 μ to 0.8 μ, R_0 from 0.8 μ to 0.4 μ, R_{-1} from 0.4 μ to 0.2 μ, etc.).

4. It is desirable to reserve the word *density* to designate the quotient of mass by volume.

The titles of the papers read were as follows:

'On anomalous propagation of electric waves,' by M. I. Pupin.

'A search after a new source of electromotive force,' by H. A. Rowland.

'The theory of certain magneto-optical phenomena,' by H. A. Rowland.

'On the heat of Arcturus, Vega, Jupiter and Saturn,' by E. F. Nichols.

'On cyanine prisms and a new method of exhibiting anomalous dispersion,' by R. W. Wood.

'On the propagation of cusped waves and their relation to the primary and secondary focal lines,' by R. W. Wood.

William Hallock.

AMERICAN MATHEMATICAL SOCIETY.

The American Mathematical Society held its seventh annual meeting at Columbia University, New York City, on Friday, December 28, 1900. About forty persons, including thirty-three members of the Society, were in attendance during the two sessions. Vice-President Thomas S. Fiske occupied the chair. A special feature of the meeting was the election of officers and other members of the Council. Under recent amendment of the Constitution, taking effect at this meeting, the president of the Society is elected for a term of two years and is ineligible for immediate reelection. The number of members of the Council elected annually is increased from three to four. This provision with the recent inclusion of ex-presidents as permanent members brings the present membership of the Council up to twenty-four. The newly elected officers are: President, Eliakim Hastings Moore; Vice-Presidents, Thomas S. Fiske and Henry S. White; Secretary, F. N. Cole; Treasurer, W. S. Dennett; Librarian, Pomeroy Ladue; Committee of Publication, F. N. Cole, Alexander Ziwet, Frank Morley; Members of the Council to serve for three years, E. W. Brown, H. B. Fine, T. F. Holgate, W. F. Osgood; Member of the Council to serve for two years, E. W. Hyde.

During the six years since its reorganization as a national body, the history of the Society has been one of constant and rapid development. The membership has grown from 244 in 1894 to 357 at present. In 1894 the number of papers read at the meetings was 24; in 1900 it was 115. Since 1894 summer meetings have been regularly held, supplemented on two occasions by colloquia or special courses of lectures. These have done much to bring the members together and to create a more general interest. The rapid expansion of the Society led in 1898 to the formation of the Chicago Section, which fosters the interest of the Society in the West. By the founding of the *Transactions*, which has just completed a very successful first year, improved facilities have been provided for the publication of important papers read before the Society. A gratifying recognition of the Society's usefulness and efficiency is found in the liberal financial cooperation of ten leading universities in the publication of the *Transactions*. The *Bulletin*, which was founded in 1891 as a historical and critical review, has been greatly enlarged, although confining itself more strictly than before to its special field.

The administration of the business of the Society has been wisely left from the beginning in the hands of the Council, the time of the meetings being thus economized for the purely scientific proceedings. The

finances of the Society are in a satisfactory condition, a moderate reserve fund having been slowly accumulated. The Society also possesses a considerable library, as yet of unbound journals and works. It is hoped that arrangment can soon be made for binding the books and making them accessible to the members.

At the annual meeting the following twenty-five persons were admitted as members of the Society.

Dr. G. N. Bauer, University of Minnesota; Dr. J. R. Benton, Princeton University; Dr. H. F. Blichfeldt, Leland Stanford University; Dr. G. A. Bliss, University of Minnesota; Professor Joseph Bowden, Adelphi College, Brooklyn, N. Y.; Professor D. F. Campbell, Armour Institute, Chicago, Ill.; Dr. J. E. Clarke, Gilbert School, Winsted, Conn.; Dr. Euplio Conoscente, New York, N. Y.; Mr. Arthur Crathorne, University of Wisconsin; Mr. H. W. Curjel, Birkdale, Eng.; Professor L. M. Defoe, University of Missouri; Mr. B. S. Easton, University of Pennsylvania; Dr. L. P. Eisenhart, Princeton University; Mr. U. S. Hanna, University of Indiana; Mr. L. I. Hewes, Yale University; Mr. A. M. Kenyon, Purdue University; Professor C. N. Little, Leland Stanford University; Mr. E. L. Milne, University of Illinois; Mr. H. B. Mitchell, Columbia University; Dr. Asutosh Mukhopâdyây, Calcutta, India; Mr. W. S. Nichols, New York, N. Y.; Professor J. M. Page, University of Virginia; Dr. T. H. Taliaferro, Pennsylvania State College; Miss R. H. Vivian, University of Pennsylvania; Dr. N. R. Wilson, Royal Military Academy, Kingston, Canada. Six applications for membership were received. The Annual Register of the Society, containing a complete list of members, the constitution and by-laws, reports of the secretary, treasurer and librarian, etc., is now in press.

The following papers were read at the annual meeting:

(1) Dr. VIRGIL SNYDER: 'On some plane curves having factorable parallels.'

(2) Professor E. D. ROE: 'On a formula of interpolation.'

(3) Mr. W. B. FORD: 'Dini's method of showing the convergence of Fourier's series and of other allied developments.'

(4) Dr. EMORY MCCLINTOCK: 'A simplified solution of the cubic.'

(5) Professor W. F. OSGOOD: 'On the minimum property of an external that meets its envelope.'

(6) Mr. C. J. KEYSER: 'Theorems concerning positive definition of finite assemblage and infinite assemblage.'

(7) Professor M. I. PUPIN: 'Wave propagation over bridged wave conductors.'

(8) Professor MORLEY: 'On a point in Sylvester's theory of canonical forms.'

(9) Professor HARRIS HANCOCK: 'On primary prime functions in several variables and a generalization of an important theorem of Dedekind's.'

(10) Dr. J. I. HUTCHINSON: 'On some birational transformations of a Kummer surface into itself.'

(11) Miss R. G. WOOD: 'The collineations of space which transform a non-degenerate quadric surface into itself.'

(12) Professor H. E. SLAUGHT: 'The complete form system of invariants of the group of 120 quadratic Cremona transformations of the plane.'

(13) Dr. JAMES MACLAY: 'Some geometrical theorems connective with a class of differential equations derived from Poisson's equation

$$\frac{\partial^2 z}{\partial t^2} = a^2\left(\frac{\partial^2 z}{\partial x^2} - \frac{mz}{x^2}\right).'$$

(14) Mr. J. K. WHITTEMORE: 'A note on cones of the second degree osculating developable surfaces.'

(15) Professor E. O. LOVETT: 'The types of line-sphere transformation.'

(16) Professor E. O. LOVETT: 'Note on differential geometry of n-dimensional space.'

(17) Dr. L. P. EISENHART: 'A demonstration of impossibility of a triply asymptotic system of surfaces.'

(18) Professor MAXIME BÔCHER: 'Some cases in which the identical vanishing of the Wronskian is a sufficient condition for linear dependence.'

After the meeting many of the members dined and spent the evening together.

The Chicago Section of the Society held its usual winter meeting at the University of Chicago on December 27th-28th. A report of the sectional meeting will appear later in this JOURNAL.

The next meeting of the Society will be held in New York on Saturday, February 23d. The Chicago Section will meet on

Saturday, April 6th. The summer meeting of the Society will be held at Cornell University, beginning on Monday, August 19th. Arrangements are being made for a colloquium in connection with the summer meeting. The committee in charge is now able to announce that Professor E. W. Brown will give a course of six lectures on 'The modern methods of dealing with the problems of dynamics and especially those of celestial mechanics,' consisting mainly of the work of Poincaré in this direction. A second course of lectures will also be arranged.

F. N. Cole,
Secretary.

THE AMERICAN CHEMICAL SOCIETY.

The first session of the twenty-second general meeting of the American Chemical Society was held in Lewis Institute, Chicago, Ill., on Thursday, December 27, 1900. The session was called to order by President McMurtrie, in the chemical lecture-room of the Institute at 10.15 A.M. Dr. W. R. Smith, chairman of the Chicago section of the Society, was introduced and welcomed the chemists on behalf of the local section. He was followed by Howard S. Taylor, Esq., prosecuting attorney for the city of Chicago, who addressed a few words of welcome on behalf of the city and its citizens. President McMurtrie responded briefly on behalf of the Society, thanking the speakers for the cordial words of welcome.

After a few announcements a paper on 'Correction in the Determination of Urea by the Liebig Method,' was read by J. H. Long. This was followed by another paper by the same author, on 'Preliminary Note on the Optical Rotation of Certain Tartrates in Glycerol.' The latter paper was discussed by Messrs. W. A. Noyes and Long. A paper on 'The Decomposition of Sodium Nitrate by Sulphuric Acid, Part Two,' by C. W. Volney, was read by the author. Edward Gudeman presented a brief paper on arsenical poisoning, which was discussed by Messrs. Springer, Volney and Gudeman, and Miss Fossler. Two papers by C. L. Parsons, entitled 'A Simple Test for distinguishing Oleomargarine from Butter,' and 'The Use of Metallic Sodium in Blow-pipe Analysis,' were read by the Secretary in the absence of the author.

A photograph of the assembled chemists was taken, and, after a few announcements, the morning session was adjourned At the close of the session luncheon was served in the building, through the courtesy of the authorities of the Lewis Institute.

The Council of the Society met at the Lewis Institute at 1.30 P.M. Other members of the Society participated in visits to the works of Messrs. Frazer & Chalmers, the Consumers Ice Company, and the Eisendraht tannery of the American Hide and Leather Company.

The evening session of the Society was held in the banquet hall of the Auditorium Hotel. Dr. W. R. Smith, vice-president of the Society and chairman of the Chicago section, presided. The retiring president, Dr. William McMurtrie, delivered an address on 'The Condition, Prospects and Future Educational Requirements of the Chemical Industries.' After a few announcements the session adjourned, and the visiting chemists enjoyed a 'smoker' given by the members of the local section at the Technical Club, 230 South Clark street.

The session of the meeting on Friday was held in the chemical lecture room of the Northwestern University Medical and Pharmacy School, 2421 Dearborn Street. The meeting was called to order by President McMurtrie at 9.30 A.M.

The annual reports of the Secretary, the Treasurer and the Librarian were presented in order and read by the Secretary. These reports were accepted by the Society and

ordered placed on file. President McMurtrie made a few remarks regarding the thorough work which had been accomplished by the Librarian during the past year, and on motion of Dr. Hart the thanks of the Society were voted to the Librarian for his successful and faithful services.

The editor presented a brief oral report of his work.

Reports received by the Secretary from F. W. Clarke, chairman of the Committee on Atomic Weights and also chairman of the International Committee on Atomic Weights, were presented by the Secretary in the absence of Mr. Clarke, and were read by title and referred to the Committee on Papers and Publications.

The Secretary reported from the Council that that body had considered the question referred to it by the Society at the New York meeting with reference to the passage of H. R. Bill 104, looking to the adoption and use of the metric system, and had decided to recommend that the Society lay the question on the table. By a vote of the Society the recommendation of the Council was adopted and the question was laid on the table.

The Committee on Standards for Instruments of Measure reported progress through Messrs. Munroe and Linebarger, who urged immediate action on the part of the membership with reference to the bill now pending in Congress to establish a National Standards Bureau.

The Secretary presented a motion urging the appointment of a committee to consider the adoption of a permanent badge or pin by the Society. The motion being seconded, it was moved and carried that the whole matter be laid upon the table.

After some announcements W. A. Noyes presented a paper on 'Synthesis of Derivatives of Dimethyl-cylopentanone] and of Beta Beta Adipic Acid and of Alpha Beta Beta Tri Methyl Adipic Acid.' Dr. Noyes also presented a paper by himself and W. M. Blanchard on 'A New Hydroxy Dihydro-campholytic Acid.'

After some other announcements Professor A. B. Prescott presented a paper by B. F. Trowbridge, entitled 'Notes on Sugar Beet Analysis.' This was followed by a paper 'On Hematite Crystals,' by Charles E. Munroe.

The remaining papers on the program were read by titles.

On motion of Dr. Alfred Springer, the thanks of the Society were extended unanimously to the Chicago Local Section; the Local Committee of Arrangements for the meeting, the authorities of the various institutions which had extended courtesies to the Society during its meeting, and the proprietors of the various works which had been thrown open to inspection by the visiting chemists.

The Local Committee made some announcements with reference to a proposed excursion to South Chicago on Saturday morning, and the meeting of the Society was then adjourned. In the afternoon the chemists enjoyed an excursion and visit to the Stock Yards Industries, and at 7 P.M. a subscription dinner was given in the banquet hall of the Auditorium Hotel.

ALBERT C. HALE,
Secretary.

SCIENTIFIC BOOKS.

The Mammals of South Africa. By W. L. SCLATER, M.A., F.Z.S., Director of the South African Museum, Cape Town. Vol. I. Primates, Carnivora and Ungulata. With a map and illustrations. London, R. H. Porter. 1900. Medium 8vo, pp. i–xxx+1–324, with map and 80 text cuts.

Smuts's 'Mammalium Capensium,' published in 1832, a small quarto in Latin, is the first and only attempt to present an account of the mammals of South Africa prior to the work here under notice, of which the first volume has just appeared. Hence the desirability of a good

manual of South African mammals is apparent. This, we are happy to say, is now being provided by Mr. Sclater in the form of a large octavo work in two volumes, beautifully printed and well illustrated with, for the most part, excellent text cuts, many of them prepared especially for the work. The region here included is that portion of Africa south of the Cunene and Zambesi rivers.

South Africa has a comparatively rich mammalian fauna, the three orders here treated—the Primates, Carnivora and Ungulata—numbering 95 species and 8 additional subspecies, while the remaining orders—the Chiroptera, Insectivora, Rodentia, Edentata and Cetacea—to be treated in Volume II., will doubtless raise the number to considerably more than 200. In the present work the author informs us he has endeavored 'to collect together all the information at present available on the subject of South African mammals,' but he has been hampered in its preparation by lack of specimens and by paucity of information regarding the life-history of the species. He has, however, laid a good foundation for further additions and given a most excellent and useful summary of the subject. A bibliography of the more important separate works relating to South African mammals occupies pp. xi–xix, and following the synonymy under each species is a paragraph, under the heading 'Literature,' giving further references.

The work is well designed to serve as a convenient manual, the higher groups being defined, and keys are provided to the genera and species, and the descriptions are fairly full. The text is further paragraphed under 'History,' 'Distribution,' 'Habits,' etc., where whatever is known of the species is briefly summarized.

In respect to nomenclature, it is well to note that the twelfth edition of Linnæus, instead of the tenth is taken as the starting point, and that specific names when employed for genera are discarded in their specific sense, so that we have, for example, *Suricata tetradactyla* instead of *Suricata suricatta*, although the latter is the older name; and *Oreotragus saltatrix* instead of *Oreotragus oreotragus*, etc. As usual with English authors, only two genera are recognized in the family Otariidæ, all the species but one being referred (p. 118) to the genus *Arctocephalus*, the type of which is wrongly given as *A. ursinus*; while the wholly undeterminable name *A. pusillus* (Schreber) is used for the single South African species, instead of the correct name *A. antarcticus* (Thunberg).

This volume is the second in point of issue—Volume I. of the late Dr. Stark's 'Birds of South Africa' being the first—of a 'series in which it is proposed to give an account of the Fauna of Africa south of the Zambesi and Cunéné Rivers,' under the general title 'The Fauna of South Africa,' under the editorship of Mr. W. L. Sclater, the author of the mammal volumes of the series. The second volume of the birds is in course of preparation by Mr. Sclater, from MSS. left by Dr. Stark, who was killed early in the present South African war.

J. A. A.

Report of the U. S. Commissioner of Fish and Fisheries for the Year ending June 30, 1900. By George M. Bowers. Washington, Government Printing Office. 1900. Pp. 191.

The report of the Commissioner of Fish and Fisheries, for the year ending June 30, 1900, again shows an increase of fish distributed of a round hundred million, consisting chiefly of shad, cod, flatfish, whitefish and lake trout. Whitefish, shad and cod stand at the head of the list, the totals being about 337, 265, and 241 millions, respectively. The year, on the whole, has been a good one and the results commensurate with the steady expansion of operations, while local accidents of climate have, in a few cases, reduced the normal output. In California the drought of last year considerably affected the spawning migrations of the quinnat salmon. On the Rogue river, in Oregon, an innovation in the food of quinnat fry, in the way of using canned salmon scraps, was attempted with promising results. In Michigan, the close season was amended to allow the National Commission to take whitefish and lake trout for fish-cultural purposes, with the result of very large collections at a minimum expenditure. The Commission moreover operated the Michigan whitefish hatcheries at Detroit and Sault Ste., Marie, for which the State did not provide

this year. Most of the whitefish output was obtained from 'penned' fish, a method of holding the fish until ripe, which has now an assured place in fish-cultural operations. Seasonal difficulties affected unfavorably the pike-perch in Lake Erie and Vermont, though a total of 90 million eggs and fry was distributed.

The New England stations propagating the great marine food species were unusually successful. Cod were hatched in excess by 50 million of any previous record. The interesting experiment of tagging adult codfish for the purpose of acquiring data on their migrations and growth was continued, 1,311 being returned to the ocean in November from the Wood's Holl Station, of which 11 were captured, some as far south as New Jersey, before the close of the year. A new method was followed in flatfish culture, consisting in allowing natural spawning in tanks in place of fertilizing artificially, the results indicating the superiority of this means of obtaining fertilized eggs of this species.

Three new stations were put in commission—at Bullochville, Ga., Edenton, N. C., and Nashua, N. H., devoted chiefly to the salmonoids, shad and bass, making a total of 35 operated during the year.

The weather considerably shortened the shad season on the Potomac, but an unusual run occurred on the Delaware, the price falling to nearly nothing. The success here and on the Susquehanna made possible a large total output, a gain of several millions over the preceding year. The basses and crappie were in unusual demand, but the development of the collecting work on the Mississippi and Illinois rivers—by which fingerling bass that would otherwise be sacrificed are taken from the 'back' waters of the river, throwing the fish-cultural work upon nature—met all demands at a nominal expense.

Encouraging reports come from Montana and Colorado of the establishment of brook and steelhead trout in waters very recently without these valuable species. Captures of a few specimens in other cases indicate the process of establishing rainbow trout in Maine and Tennessee, Swiss trout in the Adirondacks, and quinnat salmon in Lake Ontario. The Chesapeake and Ohio canal was seined prior to drawing off the water for the winter, for a distance of 92 miles, and some 90,000 fish of many species transferred to the Potomac.

Notable among the biological investigations of the Division of Scientific Inquiry are the oyster experiments at Lynnhaven Bay, Va. These are directed toward a practical method of fattening oysters by the use of a commercial fertilizer through the medium of their diatomaceous food, the diatoms appropriating the fertilizer. The experiments are made in an enclosed and tideless claire and have achieved a definite measure of success in demonstrating the possibility of fattening oysters to marketable condition by this means. The process is slower, however, than demanded for commercial purposes, and modifications of the conditions have been made which provide for artificial currents in the claire, thus approaching more nearly the conditions of nature.

The failure of the North Carolina oyster-beds has been taken up by the Commission, and the steamer *Fish-Hawk* spent the fall and winter on important portions of the grounds. A report upon the subject is in preparation. Eastern oysters have become well acclimatized in San Francisco Bay and support an industry yielding a half-million of dollars annually in mature oysters with the quantity and value on the increase. The conditions at Willapa Bay, Washington, were examined with reference to the fate of a plant of eastern oysters made there in 1894. It appears that the water is colder than is favorable for the setting of the spat. Nothing came of the plant, and while reports show that a large proportion of them were alive a year after planting, the original oysters have now almost entirely disappeared and there is a presumption of depredations upon these grounds. A method of obtaining spat from shallow ponds constructed for the purpose was recommended, the spat to be then planted in the bay. In connection with the failure of eastern oysters to multiply in the colder waters of our northwestern coast, oysters of northern Japan are to be transplanted to Washington waters.

The Wood's Holl laboratory has undergone expansion in equipment, the amount of work done, particularly in devoting, at the suggestion of the Commissioner, the museum room

to the purposes of the library. This change gave great satisfaction to the investigators, who were in greater number than usual. The work carried on included some chemical determinations of the connective tissue of the ocean sunfish, with a view to its value in making glue, and of lobster chitin in the hope of discovering for it a commercial use; diseases of fishes, anatomy of the star-fish, and of the alimentary tract of the flounder; photography and sketching of living marine forms. A series of publications has been planned which is to embrace all the invertebrate groups of the region. The Beaufort, N. C., laboratory completed the first year of its existence and concerned itself, among other things, with the breeding conditions of some fishes, sponges and parasitic crustaceans, the latter including a barnacle (*Dichalaspis*) on the gills of the common blue crab; spawning habits of certain food-fishes; life history of brittle stars; effects of abnormal conditions on the development of oyster eggs and those of other molluscs; the development of a common annelid (Axiothea) which forms part of the food of bottom-feeding fishes, and the food of the hog-fish and croaker. An observation is made on the inferior flavor of the hog-fish taken at Beaufort, which reduces its value as a food-fish as compared with the same species taken, for instance, at Norfolk. One cause of the undesirable flavor is traced to the interesting form Balanoglossus. The Beaufort laboratory is happily located for the purposes of marine biology, and now that a permanent establishment has been authorized by Congress continuous systematic studies on broad lines may be anticipated.

In accordance with the direction of the last Congress, a special lobster and clam investigation, for the purpose of remedying the marked decline in these fisheries, has been instituted. With the lobster, efforts are directed toward methods of rearing the larvæ through the early defenseless stages before liberating. With the clam it is apparently feasible to apply the methods of planting which are so extensively used with the oyster. The work has begun during the past summer and is proceeding satisfactorily.

Some work on variation in the common mackerel, begun in 1898, with a view to the question of its separation into geographical races—a fact demonstrated by an English investigator, Mr. Walter Garstang, for British mackerel—was continued during the summer of 1899, and confirms Mr. Garstang's observation of a marked difference between American and British mackerel. As for recognizable American races the material examined, as far as it goes, tends to show that such do not exist. The data, however, from the extremes of the range of the species are not yet complete.

Collections of aquatic fauna and general biological observations have been carried on in Cobbosseecontee and Sebago Lakes in Maine, in Seneca Lake, New York, in Lake Mattamuskeet, N. C., in West Virginia, in the Wabash Basin, Indiana, and in California, Oregon and Arizona. The biological survey of Lake Erie was carried on as usual throughout the summer, with headquarters at Put-in Bay, plankton studies forming an important part of the work. The collections made by the *Fish-Hawk* expedition to Porto Rico in 1899 have been distributed to specialists in the various groups. The report on the fishes was issued during the last days of the year, the others are approaching completion and it is probable that all will be published during the next fiscal year.

Dr. H. F. Moore submits an outline of the recent extensive cruise of the steamer *Albatross* in the South Seas. This expedition left San Francisco in August, 1899, Mr. Alexander Agassiz in charge of the scientific work, assisted by a party of seven, four of whom represented the Commission. The *Albatross* cruised for over six months among the South Sea Islands, visiting the Marquesas, Paumotus, Society, Tonga, Fiji, Ellice, Gilbert, Marshall and Caroline Islands and Guam. Accounts of the voyage have appeared in these columns. In the Tonga group the trawl was used in 4,173 fathoms, the deepest trawl haul ever made. The work of the party concerned the zoology, geology, ethnology and botany of the island groups, the director devoting himself to the coral formations. The officers of the vessel made surveys and nautical observations. The *Albatross* reached Yokohama in March of the present

year and spent three months trawling and dredging on the coast of Japan. In June she sailed for Alaska on commercial investigations of the Alaska salmon fisheries.

The statistical canvasses have this year covered New England, New York and Lake Erie, and in May the canvass of the Pacific coast was begun. The figures for New England show a moderate falling off in value of fishery products since the last tabulation in 1889, and also in the amount of invested capital, the latter caused by the transfer of the menhaden industry to New York. The lobster fishery has the remarkable record of a diminution, since 1889, of over 50 per cent. in quantity and a coincident increase of over 50 per cent. in value. The total value of New England fisheries reaches over nine and one-half millions. Lake Erie and Lake Ontario come forward with a large increase in quantity and value, the whitefish, a species very extensively propagated by the Commission, sharing largely in this expansion. Over three and one-half million pounds of the much-abused carp were taken from the American waters of the lake in 1899, with a value of over $50,000. Indeed, a glance at the figures for this species shows that the carp is certainly the most valuable fresh-water fish after the whitefish and its allies, the pike perch and the lake trout, and should afford food for thought to those who condemn the carp as an unmitigated evil. The Illinois Fisherman's Association reports the catch in the Illinois river as greater in quantity than that of all other species combined, with a value of nearly $200,000. Carp have increased many fold in the Middle Atlantic States and the Middle West during the last decade, the quantity taken in Lake Erie, the Illinois river, and the Ohio river and its tributaries, during 1899, being nine times that of six years ago.

The annual visit to the fur-seal rookeries on the Pribilofs shows the continued decline of the seal herd as a consequence of the continuance of pelagic sealing. The number of seals taken from the islands under government supervision was 16,812, and the pelagic catch from the American herd some 34,000.

M. C. MARSH.

A Handbook of Photography in Colors. By THOMAS BOLAS, ALEXANDER H. K. TALLENT and EDGAR SENIOR. Published by Marion and Co., London. American edition by E. & H. T. Anthony, New York and Chicago.

The authors of this book have brought together in compact form the very scattered literature pertaining to color photography. Part I., by Mr. Bolas, contains a brief history of helichromy, from the early work of Seebeck, Herschel and others until the present day, covering about the same ground as the new edition of Zenker's 'Lehrbuch der Photochromie.' His account of Wiener's work and suggestions regarding the possibility of getting a truly chromo-sensitive surface will be found of use by any who are engaged in the hitherto fruitless search of a substance which when exposed to colored light will assume permanently the color of the illuminating light. That such a surface is theoretically possible is clearly shown, and methods of realizing it in a crude way are given.

The general principles of the various processes are given, including those of Joly, Ives, Lippmann and others. Lippmann's account of his interference process as delivered in English before the Royal Photographic Society is given verbatim. His picture of the formation of the thin laminæ which produce the colors by the stationary light waves is interesting. It will be remembered that these stationary waves are produced by backing the sensitive film with mercury. "If you put no mercury," says Lippmann, "each train of waves rushes through the plate and wipes off every record of its own form by reason of its velocity; you cannot expect a thing which moves with a velocity of 300,000 kilometers a second to give a photograph of itself. If you put a mercury mirror behind the plate, then the following phenomena occur: the light is reflected back on itself; the light rushes in with the velocity of light, and rushes out with the same velocity; the entering and issuing waves interfere, and the effect of interference is that vibration takes place, but the effects of propagation are stopped, and instead of having propagated waves, we get stationary waves; that is, the waves

now rise and fall each in its own place; they pose, therefore, in the film and impress their form upon it, the largest movement giving the largest impression, and where the movement is naught the impression is naught."

Part II., by Mr. Tallent, is devoted to three-color photography. It opens with an elementary treatment of spectrum work as applied to the study of color and color mixtures. Following this comes a very complete account of color curves, and the reproduction of various colors by the synthesis of three primary spectrum colors. Ives's beautiful method is again described, together with fuller details regarding the preparation of color records, the preparation and use of color filters and other details. The various other modifications of the three-color scheme are treated, closing with a chapter on Wood's diffraction process. It seems a pity that fuller working details of some of the methods of producing colored transparencies by the superposition of dyed films, are not given. However, there are hints enough to enable one to experiment along these lines if so inclined.

Part III., by Mr. Senior, is a dozen or so pages on the Lippmann process, with formulæ for the preparation of the emulsion. There is a good deal of repetition in the book, as is usually the case in symposia of this sort. It will, however, be found very useful as a reference book by those desirous of experimenting with any of the processes.

R. W. W.

BOOKS RECEIVED.

Lectures on the Lunar Theory. JOHN COUCH ADAMS. Edited by R. A. SAMPSON. New York, The Macmillan Company; London, Cambridge, University Press. 1900. Pp. 88. $1.25.

Knowledge, Belief and Certitude. FREDERICK STORRS TURNER. New York, The Macmillan Company; London, Swan, Sonnenschein & Company. 1900. Pp. viii+484. $2.25.

Engineering Chemistry. THOMAS B. STILLMAN. Easton, Pa., The Chemical Publishing Company. 1900. Vol. II., pp. xxii+503. $4.50.

Elementary Organic Analysis. FRANCIS GANO BENEDICT. Easton, Pa., The Chemical Publishing Company. 1900. Pp. vi+86. $1.00.

A Text-book of Urine Analysis. JOHN H. LONG. Easton, Pa., The Chemical Publishing Company. 1900. Pp. iv+249. $1.50.

Evolution of the Thermometer. HENRY CARRINGTON BOLTON. Easton, Pa., The Chemical Publishing Company. 1900. Pp. 98. $1.00.

The Chemists' Pocket Manual. RICHARD K. MEADE. Easton, Pa., The Chemical Publishing Company. 1900. Pp. vii+204. $2.00.

Handbook of Practical Hygiene. D. H. BERGEY. Easton, Pa., The Chemical Publishing Company. 1899. Pp. 164. $1.50.

Concretions from the Champlain Clays of the Connecticut Valley. J. M. ARMS SHELDON. Boston. 1900. Pp. 45. Plate xiv.

Annual Report of the State Geologist of New Jersey for the Year 1899: Forests. Trenton, N. J., MacCrellish & Quigley. 1900. Pp. xvi+327.

Nature's Miracles: Electricity and Magnetism. ELISHA GRAY. New York, Fords, Howard & Hulbert. 1900. Pp. vi+248. $.60.

SCIENTIFIC JOURNALS AND ARTICLES.

THE January *American Journal of Physiology*, the concluding number of Vol. IV., records in the initial paper further interesting results obtained by Loeb in his study of artificial parthenogenesis. Loeb has caused the eggs of Chætopterus, an annelid, to develop into free swimming larvæ by simply placing the eggs in various solutions which cause them to lose water. Potassium ions, however, have peculiar power over these eggs which grow to the trochophore stage in a KCl solution with an osmotic pressure considerably lower than that of sea water. A slight addition of HCl to the sea water also causes the eggs to develop. Loeb carefully observed the morphological changes in the eggs during their development, and found that although the artificially produced trochophores may be indistinguishable from those arising from fertilized eggs, yet the processes of segmentation varied so greatly that these processes must be regarded as distinctly a function of the constitution of the sea water. These observations, together with those on the formation of giant embryos by the fusion of two or more eggs, have an important bearing on developmental mechanics and cell lineage. Loeb concludes with a consideration of the relation

between natural and artificial fertilization, and of the relation of his results to the theory of fertilization and of life phenomena in general. 'The Theory of Phototactic Response' is a clarifying paper by Holt and Lee. They aim to show that organisms do not react to direction of light as well as to intensity of rays. The conditions of the organism itself must be more closely regarded. Every ray impinging on an organism stimulates it at one point and in proportion to the intensity. If the light comes to one side of the organism, that side is naturally stimulated more than the other and the response is thus determined. The two factors, intensity of light and the side of the organism the light reaches, account for all the phenomena included under phototaxis and photopathy. Reaction to the 'direction of the ray' must, therefore, be regarded as an incorrect conception, and the term phototaxis relieved of that meaning. A. P. Mathews presents a paper on the spontaneous secretion of saliva, which brings evidence against the theory of secretory nerves. On readmitting blood to the dog's submaxillary after having cut off the supply for 12 to 25 minutes, the gland secretes rapidly. This secretion is not due to nerve cells in the gland, since nerve cells are made ineffective by absence of blood supply during so long a period. The important fact is that atropine stops the secretion ; it must act directly on the gland cells. The value of this drug therefore as a witness for secretory nerves is seriously impaired.

The Journal of the Boston Society of Medical Sciences for November 20, 1900, opens with an article on 'Ergographic Studies in Muscular Fatigue and Soreness,' by Theodore Hough. T. M. Rotch notes the 'Treatment of the Proteids of Cow's Milk' and J. J. Thomas decribes, with illustrations, 'Five Cases of Injury of the Cord resulting from Fracture of the Spine,' showing among other things the difficulty of exactly locating the seat of injury and the necessity of taking into consideration the manner in which the accident took place. It is noted that early operations should be limited to cases where the neural arches are thought to be crushed and cases of knife and bullet wounds. John Dane notices 'Some Variations in the Skeleton of the Foot,' stating that some form of variation from the type of foot described in our anatomies may be expected in thirty-three per cent. of human feet.

The Popular Science Monthly for December has for its first article a paper by S. F. Peckham on 'Asphaltum for a Modern Street' telling what the material is, where it is found and how the deposits are worked. Allan Macfadyen discusses 'The Effect of Physical Agents on Bacterial Life' showing the varying effects of light, air and temperature on these simple organisms, and stating the remarkable fact that typical series of bacteria were subjected to the temperature of liquid hydrogen—250° C.—and that upon being thawed their vitality was unimpaired. L. O. Howard treats of 'Flies and Typhoid Fever' and shows the danger of infection from several excreta-frequenting species and Edwin S. Crawley has an interesting article on 'Geometry: Ancient and Modern,' Huxley's 'Address given before the Anthropological Department of the British Association, 1878' is reprinted. It is not republished in his 'Collected Essays.' William Henry Hudson gives a brief abstract of the little known 'Story of Autonous' and 'The Economic Life of France' is considered by Edward D. Jones who notes the physical conditions of various portions of that country and their related industries. Pearson's 'Grammar of Science' is unfavorably criticized by C. S. Peirce in a series of annotations on the first three chapters, and in the instalment of 'Chapters on the Stars' Simon Newcomb discusses the structure of the heavens and the distribution of the stars. Under discussion and correspondence an editor utters a well-founded protest against needless obscurity in scientific publications.

THE opening article of *The American Naturalist* for December is on 'The Study of Mammalian Embryology,' by C. S. Minot, and is a preliminary publication of portion of a text-book on which the author has been at work for a considerable time. The general plan of the work is outlined and samples are given of the fine wood cuts with which it is to be illustrated. Henry F. Osborn presents a third paper on 'The Origin of the Mammalia: Occipital Condyles of Reptilian Tripartite Type,' the con-

clusion being that the reptilian tripartite origin of the mammalian condyle is more probable than the amphibian dicondylic origin. T. W. Galloway presents some 'Studies on the Cause of the Accelerating Effect of Heat upon Growth' giving the results of experiments upon the larvæ of various amphibians and showing that all the early developmental processes were accelerated. C. B. Davenport discusses 'The Variation of the Statoblasts of *Pectinatella magnifica*' and J. B. Johnston describes 'A Sealing Stone Jar for Zoological Laboratories' which seems very useful and is sealed with a heavy paraffin oil. The title page and index of the completed thirty-fourth volume are included in this number.

On January 1st appeared the first part of 'Geologisches Centralblatt, Revue Géologique, Geological Review,' edited by Dr. K. Keilhack, Bingerstrasse, 59, Wilmersdorf, Berlin, and published by Gebrüder Borntraeger, Leipzig, at an annual subscription of 30 Marks. The American agent is G. E. Stechert. The review is to appear on the 1st and 15th of each month, and is intended to give short, uncritical notifications of the latest publications in geology and allied sciences. The abstracts are written in German, French or English, according to the language in which the original papers have appeared. Since the contributors are to be compatriots of the respective authors, this renders their task easy; but the converse method would be of more advantage to scientific workers, and unless the German printers are more careful than they have been in the first number, even the English will be unintelligible to readers in this country. There can be no doubt as to the 'uncritical' nature of the notices; but this may be carried too far. It is to be hoped that authors, by contributing their own abstracts, will forestall some of the mangling to which they are otherwise liable.

It is interesting to note that in the numerous surveys of the nineteenth century, now being published, science usually occupies about half the space. This is in curious contrast to the slight attention paid by the newspapers to contemporary science and the carelessness with which scientific news is usually complied. Several of the daily papers have published very good historical surveys of the progress of science during the century; thus the New York *Evening Post* of January 12th, contains articles on astronomy by Professor Newcomb, on physics by Professor Lodge, on electricity by Professor Trowbridge, on medicine by Dr. Billings and other interesting articles. The New York *Sun* is also publishing a history of the nineteenth century in thirteen articles of which nine are on the science as follows: 'Evolution' (Dec. 23), by Alfred Russel Wallace; 'Chemistry' (Dec. 30), by Professor W. Ramsay; 'Archeology' (Jan. 6), by Professor Flinders-Petrie 'Astronomy' (Jan. 13), by Sir Norman Lockyer; 'Philosophy' (Jan. 20), by Dr. Edward Caird; 'Medicine' (Jan. 27), by Professor William Osler; 'Surgery' (Feb. 3), by Professor W. W. Keen; 'Electricity' (Feb. 10), by Professor Elihu Thomson; 'Physics' (Feb. 17), by President F. C. Mendenhall.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB OF THE UNIVERSITY OF CHICAGO.

At the meeting of November 14th, Mr. G. A. Allen reviewed a recent paper by Duneker on variation in *Palæmonetes*, and Miss Minnie Enteman recounted her observations on the behavior of *Polistes*. Some of the more important points of the latter paper may be mentioned here:

Polistes, our common paper wasp, constructs for a nest a single flat plate of hexagonal cells without an external covering. This renders observation of its habits and instincts very easy. Among the facts gathered concerning the activities characteristic of the larval, pupal and imaginal life, the most interesting relate to those of the newly excluded worker:

1. Fear is very generally exhibited, the young worker retreating precipitately when a strange object is presented to it. This gradually diminishes with the repeated appearance of the awe-inspiring object. If the bit presented is edible the worker will, after five or six trials, come up, touch it with the antennæ and exhibit

2. The feeding instinct. This consists in crushing the food in the mandibles, and ex-

tracting its juices, which are then swallowed by the worker. When the mass has reached a pulp like consistency it is distributed to the feeding larvæ which occupy the cells of the nest. This habit has been thought to arise by imitation of the queen or an older worker, but that it is independent of such example is proved by the fact that it is acquired in all its perfection by wasps which have had no association with others of their kind.

3. The locality study. This is a mere desultory alternation of short flights and strolls, by means of which the wasp comes in contact with objects surrounding its nest. It appears to use these objects to some extent as landmarks, but experiments indicate that the olfactory sense is also an important factor in guiding it.

4. In a way the wasp remembers. This is indicated by its behavior when a change is made in its nest, and also by its accustoming itself to the appearance of strange objects.

5. Wasps learn nothing from one another. Instinct and individual experience account entirely for their complex activities, and their apparent cooperation is due to the accident of being born in the same nest.

At the session of November 28 Mr. C. M. Child gave a brief account of some zoological observations made during a recent trip to Florida, and showed a number of specimens.

Following this, Mr. E. R. Downing discussed 'Recent Experiments on Sea-Urchin Eggs,' referring chiefly to the work of Driesch.

The last session of the club for the autumn quarter was held December 12. This was devoted to a paper by Mr. C. C. Adams, entitled 'Geographical Distribution of Variations in *Io*.' The paper was illustrated by a number of lantern-slides, showing series of the shells from different localities.

The following abstract gives an outline of Mr. Adams's work on this form:

The gasteropod genus *Io* is found only in the headwaters of the Tennessee River and its tributaries. By the aid of a grant from the American Association for the Advancement of Science the Clinch and Powell Rivers were explored and the following facts concerning its geographical distribution and variations were discovered:

These shells are remarkably variable, all intermediates being found between a smooth shell (*Io fluvialis* Say) and a very spinose shell (*Io spinosa* Lea). The extremes of variation do not occur promiscuously in all localities, but are quite definite in their occurrence. In the headwaters of both streams the smooth shells form the dominant population, but farther down stream, in the case of the Clinch River within 60 miles, the entire shell population changes from a smooth to a very spinose shell. In the intermediate region the shells are mixed, smooth, spiny and intermediate.

The headwater shells in the Powell are more globular and relatively stable, have low or no spines, distance between spines small and slightly variable. Down stream the shells are less globular and relatively variable, spines high and fairly stable, distance between spines wide and variable.

In the Clinch the headwater shells are more globular (similar to those in the head of the Powell) and relatively variable, low or no spines, distance between spines small and slightly variable. Down stream the shells are less globular and relatively stable, spines are high and variable, distance between spines wide and stable.

Thus these parallel streams have parallel differences in their *Io* shells.

C. M. CHILD,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE U. S. NAVAL OBSERVATORY.

TO THE EDITOR OF SCIENCE: Every reader of SCIENCE must have been greatly interested in two recent editorials discussing the Naval Observatory at Washington and its work, but many of them will regret that where so much is said and so well said, the real meat of the controversy is left untouched, although in the last paragraph it seems to be 'scented.' Is it not true that the question in the minds of most thoughtful people is—what, in the name of reason is the use of having the Observatory for astronomical research under the Navy Department, any way?—why not just as well a geological survey? If this question be pertinent it cannot be impertinent and why do scientific

men continue to beat about the bush when they know exactly where the real quarry is?

A few years ago the pressure for a reformation in the management grew to considerable proportions and it was shrewdly met by the Navy Department in the scheme for an astronomical director. Many hopeful people without much experience rejoiced at this which they thought was a great step in the right direction. When a year or two ago the continued dissatisfaction had grown to the extent of demanding the appointment of committees by the American Association for the Advancement of Science and the Astrophysical Society, it was again as shrewdly encountered by the appointment, by the Secretary of the Navy, of the Board of Visitors whose report is unhappily meeting with criticism fore and aft. A distinguished statesman whose loyalty to the interests of the Navy Department has long been known was made chairman of this Board and it is an open secret that he peremptorily cut off all suggestions looking to the real emancipation of this great institution.

The scientific members of the Board, all most excellent astronomers, but possibly not well informed as to the methods sometimes resorted to by great statesmen, were restricted in the recommendations to proposals for repair rather than reconstruction. In spite of their limitations they succeeded in getting in a most interesting and valuable report—one in which symptoms are admirably set forth, although there is 'much silence' as to the real nature of the complaints. Is it not perfectly true that the Naval Observatory, as such, has been of little value to astronomical science, although *astronomers* attached to the establishment have contributed greatly to the glory of American science? But this is in spite of, not on account of the character of the administration of the Observatory. This administration is and must always be, and properly so, while it is under the Navy Department, military in its character. The utter incompatibility of this sort of control and direction with the best interests of scientific research needs no demonstration. The very existence of a comfortable retiring pension for astronomers who survive their sixty-second year has been unfortunate in its results, in that it has led to the appointment, through the use of influence, other than that of merit, of men whose principal ambition was old age under these conditions. Why should a regularly appointed astronomer be detailed as inspector of apparatus for fire protection at the Navy yards? What would be thought of a civil establishment which detailed one of its best paid professors of astronomy to the duties of superintendent of grounds and buildings? M.

REPRODUCTION OF DIFFRACTION GRATINGS.

To the Editor of Science: The communication of Professor R. W. Wood in your issue of January 4th (p. 33), concerning diffraction gratings, is of interest to me. I have, during the past year, made some experiments on the reproduction of gratings. Obtaining through the kindness of Professor Rowland and Mr. Schneider, a fine flat glass grating, it was silvered on its face in a silvering solution, then electroplated with silver and afterward with a heavy coat of copper. With care it could be readily removed from the glass especially if warmed. I had used the process to make concave mirrors from lens surfaces about six or seven years ago and the results were excellent, even the most minute scratches or imperfections of the glass appearing in the silvered surface with the utmost fidelity, while the polish and brilliancy was such that one could scarcely believe that the surface was not one of glass instead of polished metal. With the glass grating the experiments gave excellent reproductions of the ruling and great brilliancy, but the surface of the metal grating was not optically flat but slightly warped. This condition varied in different trials and the result would probably have been more perfect if the temperatures during the electro-depositing had been maintained rigorously the same.

It is possible that had the glass been convex the resultant concave grating would have been without distortion. Lack of time has so far prevented my trying another expedient which ought to give good results. It is to first silver the glass grating as before, then, having coated a flat glass surface with a thin layer of adhesive cement, like hard pitch or shellac warmed, or with a cement like glycerine and litharge which

sets firmly, apply this to the silver surface and allow it to harden. It should then be easy to remove the silver grating from the glass grating and the reproduction should have all the gloss and accuracy of the surface serving as the matrix. My interest in the matter was the possibility of easily and rapidly obtaining fairly good gratings without great expense, so that students in laboratories might use them without restraint. From one good glass grating numerous reproductions could be had at any time.

ELIHU THOMSON.

SWAMPSCOTT, MASS.,
Jan. 5, 1901.

THE FRICTIONAL EFFECT OF RAILWAY TRAINS ON THE AIR.

AN interesting and in some respects exceptionally important paper, read by Professor F. E. Nipher before the St. Louis Academy of Science has just been published by that Society in its transactions.* In this paper, the results of an experimental investigation of the effect of railway trains in the production of air-currents, and in causing the motion of adjacent bodies, are given with tabulated and diagrammed data. The effect of a rapidly moving express-train in producing strong air-currents is familiar to all who have seen anything of that kind of train-service, and the results of action of these fast-moving currents in overturning and in transporting objects near the track are hardly less familiar; but this is the first investigation conducted in a scientific and satisfactory manner to determine the quantitative measures of such effects. The stimulus to this particular research seems to have been the denial, by the Supreme Court of Missouri, that such effects are or can be produced.†

The station agents of all the great trunk-lines of railway over which fast trains are operated are invariably cautioned regarding this danger and are careful to warn people against standing near the track when an express train passes. Small articles, and especially bulky and light merchandise, may often be seen to move under the 'suction' so produced, and, in the case referred to, a boy standing near the track, awaiting the passing of the coming fast train, and about to cross, was overthrown and rolled under the wheels and killed. The evidence showed that he was not struck by the train and the upper part of his body was not bruised. 'He fell after part of the train had passed.' The Court, however, repudiated the evidence of two scientific men of recognized attainments and distinction, testifying to the existence of known facts and to the probability of the claim of the plaintiffs in the case. The outcome of this doubt of the evidence was the employment by Mr. Nipher of a large part of the succeeding summer in the investigations here recorded, which were carried on, on the various roads leading out of St. Louis to Burlington, Chicago and Cairo. The Illinois Central Railroad finally fitted up a special car for the work; this was employed in securing the larger part of the information published.

The difference of pressure was taken between the interior of the car and some one point, selected by the observer, in making a series of observations from contact with the side of the car to a stratum several feet from the side, and the successive differences of pressure constitute measures of the varying tendency to carry along loose bodies near the track and of the tendency, also, to rotate them. A cup-shaped collector was used and the Newtonian equation was adopted. The coefficient, for pounds per square foot and miles per hour, was found to be 0.0025, very nearly, without wind. Still air is only reached at distances of sometimes many feet from the side of the train. The curve of varying pressures relatively to the car was found to be, as plotted, approximately hyperbolic, the vertical asymptote finding its position a short distance inside the car. The pressures measured range from 3.4 to 6 pounds on the square foot, at distances of 0 to 30 inches from the side of the car; the mean speed being 38 to 46, usually about 40, miles an hour; at which speed the

* The Frictional Effect of Railway Trains upon the Air; Francis E. Nipher. *Trans. Acad. of Science of St. Louis;* Vol. X., No. 10. Issued Nov. 12, 1900.

† "When the case was tried a second time, and again resulted in a verdict against the company, the Supreme Court attacked the experts it had approved in the first reversal and threw out their uncontested evidence. * * * The Supreme Court of Missouri decides that the physical laws of the universe do not exist, so far as that august assemblage is concerned." —*St. Louis Mirror*, November 29, 1900.

head-pressure relatively to the earth would be about four pounds per square foot. Light winds, sometimes following, sometimes resisting, the train, caused some variations which were allowed for in computations.

It is to be noted that a plane surface would have given a higher resistance, by at least 50 per cent., than was recorded by the cup-shaped vane. R. H. T.

TRIVALENT CARBON.

In the *Journal of the American Chemical Society* for November appeared an article of very unusual interest. By the action of silver, mercury or zinc on triphenylchlormethane Dr. M. Gomberg has obtained a new hydrocarbon, *triphenyl-methyl*, $(C_6H_5)_3C$. For some reason, perhaps because of space relations involved, two molecules of this hydrocarbon do not unite to form hexaphenylethane, $(C_6H_5)_3\,C-C\,(C_6H_5)_3$, as would be expected. The new body is the only one among the seventy thousand or more compounds of carbon, which contains an odd number of atoms of odd valence. The compound furnishes the first opportunity of studying the properties of a substance containing a carbon atom that is almost certainly trivalent. From this standpoint, as well as others, the discovery possesses a great theoretical interest. Especially the properties of triphenyl methyl in its rapid absorption of oxygen furnish a practically complete refutation of the view that benzene, ethylene and similar compounds contain trivalent carbon. W. A. N.

COLUMBIA UNIVERSITY.

The trustees of Columbia University have authorized the publication of the following statement drawn up by President Low:

The problem of Columbia University can now be defined, for the first time since, in 1892, it was determined to move to Morningside Heights.

Cost of land and development at Morningside Heights,		$6,516,300 17
Improvements at College of Physicians and Surgeons,		879,688 43
		$7,395,988 60
Interest to June 30, 1900,		586,519 92
		$7,982,508 52

Of this large sum the University has succeeded in paying, mostly out of gifts and legacies, $4,250,000. Of its outstanding debt the sum of $750,000 is provided for. It still owes $3,000,000 that is not provided for; upon which the annual interest payable is $98,500.

Careful computations justify the undersigned in saying that eight years from now the University will be able, by the increase of income from its fees and endowments to care for its floating debt without embarrassment to its educational work. The falling in of contingent interests already definitely established may hasten this result importantly. Experience also demonstrates that the endowments of the University are likely to be constantly increased by gift and legacy year by year.

The problem of the University, therefore, is to conduct its educational work for a period of eight years without curtailment by reason of the interest to be paid in the meanwhile on its outstanding debt, say $100,000 a year.

For the academic year ending June 30, 1897, the last year at the 49th street site, the University had a deficiency on its current educational account, disregarding interest, of $48,260. For the coming academic year, 1901–1902, the estimates for the Budget already made show that the ordinary income of the University next year will pay all of its current expenses except the interest on its outstanding debt.

If our interest payable can be taken care of for eight years, the problem of the University growing out of its removal to the new site will be solved.

From the purely business point of view, the operations of the University have been already justified. Its plant has been increased in value, after deducting the proceeds of its old buildings, by more than $6,250,000, taking its new site at cost. If the new site be taken at its present market value, the increase in the value of the University's plant would be not less than $8,000,000. The debt incurred in producing these results, still remaining unprovided for, is only $3,000,000. In addition, University Hall is now being enlarged by gift; and Earl Hall is about to be erected, also by gift. In the same interval, the trust funds of the University have been increased by $1,250,-

000; the library has grown from 120,000 volumes to over 300,000 volumes; the teaching force from 226 to 361; and the number of students from 1,564 to 2,560. These figures do not include either Barnard College or Teachers College.

Since removal, also, an educational deficiency of more than $48,000 has been overcome, and the University, after this academic year, will be running within its income, after assuming the full care of its enlarged plant.

For a few years and for a few years only, the University needs help to prevent its debt from being further swelled by borrowed interest. It is not possible to take any such sum as the University needs, annually, in the immediate future, out of its educational work, without destroying its efficiency. This ought not to be be permitted: First, because the work is highly useful and is being economically and well done; second, because any curtailing of the University's educational offer would be reflected immediately in loss of earning power; and, third, because, for the credit of the city, the University must be kept where it now is, in the very front rank.

To meet this situation, appeal is made to all the friends of the higher education in New York. Friends of the University, including the President and Trustees, have already pledged $38,000 for this purpose. For the rest, the University confidently turns to the citizens of New York who value the things for which Columbia University stands in this metropolitan city.

REPORT ON A WESTERN BRANCH OF THE AMERICAN SOCIETY OF NATURALISTS.

As we have already announced, the American Society of Naturalists decided to meet next year at Chicago, and the Council was requested to report on the relations of the Society to the Western Branch, which has held two successful meetings in that city. Prior to this decision a committee consisting of Professors Henry Kraemer, G. D. Macloskie, E. B. Wilson, C. B. Davenport and T. H. Morgan made a report which we publish, in order that men of science may have an opportunity to consider and discuss a problem of considerable importance. The report of the committee is as follows:

The Committee appointed to consider the proposition offered by some of the members of the American Society of Naturalists to form a Western Branch of this Society (See Records of A. S. N., p. 29) submit the following recommendations for the action of the Society:

1. The American Society of Naturalists appreciates the desire of some of the Western members to form a Society of the Central States and, furthermore, appreciates the motives of the members to make this new Society a branch of the American Society of Naturalists. It is doubtful, however, if it will be possible to form such a branch, and if such a society is formed, we believe it should be as a distinct organization having its own officers, control of its own finances and the publishing of its own records.

2. The original intention of the Society of Naturalists was a good one, but we believe that it was unfortunate in changing its name from 'Society of Naturalists of the Eastern United States' to 'American Society of Naturalists' and in limiting the meetings to the Eastern United States. We recommend, therefore, that the original name be readopted in place of the present name. We believe this action would tend to facilitate the formation of similar societies, if desired, in different parts of the United States, and be in accord with the inception principles of this Society.

3. It is further recommended, in order to strengthen the work of naturalists in the United States, and so add to the influence of the whole body of naturalists in this country, that, if a Society of Naturalists of the Central United States be formed, or any similar society, if possible, each society appoint delegates to represent it at the Annual Meeting of the Sister Society; that the Executive Committee of the one cooperate with the Executive Committee of the other for united effort in contributing to the support of different objects such as the Naples and Wood's Holl Biological Stations; and that the societies extend to each other mutual privileges and courtesies such as: (*a*) Change in membership from one society to the other by approval of the Executive Board of both societies; (*b*) Admission of members of both societies to the meetings of either society, with enjoyment of certain privileges such as the reading of papers, taking part in the discussions and participation in such other matters as may be deemed advisable.

SCIENTIFIC NOTES AND NEWS.

MR. JOSEPH WHITE SPRAGUE, of Louisville, Ky., who died recently in Switzerland, left a will that should ultimately greatly benefit the

Smithsonian Institution. It gives 85 per cent. of the interest on the estate to relatives for life. On their death the entire property, increased by 15 per cent. of the income to be laid by each year, is held in trust for twenty years, and then reverts to the Smithsonian Institution. One-half of the annual income is then to be added to the principal each year, and the other half is to be used for the advancement of the physical sciences by prizes, lectures or original research. It is estimated that the fund now is worth $200,000, and that it will be available in about fifty years.

A BILL has been introduced in the House of Representatives directing the general government, through the Secretary of the Interior, to secure title to the cliff dwellers' region of New Mexico for park and scientific purposes, and one in the Senate appropriating $5,000,000 for the purchase of land in the Appalachian Mountains for a national forest reserve.

THE Washington Academy of Sciences is endeavoring to secure a permanent home for the Academy and the nine local societies which are affiliated with it. A lot has been purchased on 15th Street, between L and M Streets, northwest. It is hoped that funds enough can be secured to warrant the erection of a building containing a large hall for various public meetings and small rooms for the different purposes of the various societies.

DR. H. R. MILL will, as we learn from *Nature*, join Mr. Sowerby-Wallace in carrying on the British Rainfall Organization, in continuation of the work of the late Mr. G. J. Symons.

WE regret to learn that the *Philadelphia Medical Journal* will no longer be edited by Dr. George M. Gould. The Journal has been edited by Dr. Gould since its establishment and has been made by him one of the half-dozen valuable medical journals of the United States.

IN commenting on the election of Professor W. W. Campbell to the directorship of the Lick Observatory, the *Astrophysical Journal* says: "The wisdom of this choice will be apparent to every one familiar with the circumstances of the case. The task which falls to the successor of Professor Keeler is no easy one, a fact which the Observatory Committee fully appreciated. They accordingly deferred action until the opinions of many eminent astronomers in this country and abroad could be secured. The replies, almost without exception, named Professor Campbell as first choice. It is evident that his remarkable success as an investigator, his tireless energy and his ability to direct the works of others are widely known and appreciated. It is a pleasure to extend congratulations to the President and Regents of the University of California for the wise manner in which the appointment was made; to the Lick Observatory for its bright prospects under such leadership, and to Professor Campbell himself for the wider opportunity in the prosecution of his researches which he will now enjoy."

DR. W. WALDEYER, professor of anatomy at Berlin, has been elected a member of the Moscow Natural History Society.

IT is understood that Lord Kelvin will give an address on the textile industries at the annual dinner of the governors of Yorkshire College, on February 1st.

A MARBLE bust of Friedrich Gustav Gauss is to be made and placed in the lecture room for geodesy and mathematics at the University of Berlin.

THE death is announced on December 30th of Mr. William Pole, F.R.S., formerly professor of civil engineering in University College, London, an eminent writer on engineering subjects and an active member of a number of Government commissions of inquiry. He was a man of wide interests, being a gifted musician and student of music and the author of the well-known 'Evolution of Whist.'

WE also regret to learn of the death of Mr. Philip Crawley, fellow of the Zoological and Linnean Societies of London, and the possessor of collections of birds' eggs and butterflies, said to be among the finest in the world; of Mr. F. R. Bedford, a young English zoologist, known for his studies on the echinoderms, and of Senhor Cordeiro, Secretary of the Portuguese Geographical Society.

THE Chicago Medical Society has adopted a resolution protesting against the duty of 20 per cent. on pathological specimens.

IN accordance with the recommendation of Governor Odell, a bill has been introduced in the New York Assembly abolishing the present Forest Preserve Board and transferring its duties to a Forest, Fish and Game Commission. This Commission would have a president with a salary of $5,000 and two other members appointed from the commissioners of the Land Office without extra salary.

As a part of the work of the Geological Survey in Alaska this year, an arctic party will proceed from Bergman on the Koyukuk River by the Allen Kakat River to the divide, then down some stream to the arctic coast and along the coast southward and westward. Another party will go westward from Bergman down the Kowak River to Kotzebue Sound. Another party will continue investigation of the Copper River region.

WE learn from the *Irish Naturalist* that Professor A. C. Haddon, and Messrs. H. J. Seymour, R. L. Praeger and Halbert, have been investigating the Cave of Dunmore in County Kilkenny, Ireland, both as regards its geology and its past and present fauna, and have taken a number of the small animals which render the Mitchelstown cave so interesting.

A COLLECTION of marine, fresh-water and land shells, made by the late Sir James Emerson Tennent, Governor of Ceylon, has been presented to the Municipal Museum of Belfast, Ireland, by the executors of the late George Horner, who had purchased it from a previous owner.

THE Hon. E. S. Converse has given $125,000 for an endowment fund for the Malden Public Library, established by him.

THE daily papers report that the Finlay theory of the propagation of yellow fever by mosquitoes has been further confirmed by the commission now studying the subject in Cuba. Cable dispatches state that a monkey which had been bitten by an infected mosquito developed on the fourth day well-marked symptoms; that of six non-immunes bitten by mosquitoes which had previously bitten yellow fever patients, five developed yellow fever, while subjects who slept in infected clothing and bedding, but were guarded from mosquitoes, were untouched.

THE plague has broken out at Vladivostock with nineteen cases of which fifteen have been fatal.

ON the afternoon of December 7, 1900, there passed over northern Colorado and southern Wyoming a magnificent fireball, which was so brilliant that some observers described it as rivaling the sun. It exploded when passing over North Park, Colorado, its detonations inspiring animals with terror and startling people. Some reports state that the earth was shaken and windows in houses broken. The Chamberlin Observatory has sent circulars broadcast over the State and has utilized the newspapers thoroughly in an endeavor to gather information. The data obtained have been placed in the hands of Miss Lela L. Stingley, of the University of Denver, for discussion and publication.

MR. A. G. S. JOSEPHSON, of the John Crerar Library, submitted, at a recent meeting of the Bibliographical Society, of Chicago, a plan for a complete bibliography of American literature on cards, thus making it possible to issue to subscribers, during the course of its preparation, cards for either the whole work or for any part thereof. The plan provides for the organization of a Bibliographical Institute, either specially endowed or supported by contributions from scientific societies and institutions. The Society voted that a committee of three be appointed to consider ways and means for carrying out the plan, and the President, Professor Camillo von Kleuze, appointed as members of the committee Messrs. Clement W. Andrews, Frederick H. Hild and Carl B. Roden.

IN the spring of last year the London *Times* published a series of articles on American engineering competition that attracted much attention. The articles are now being continued, and it is sought to explain the growing place taken by American manufactures throughout the world, including Great Britain. Apart from the natural resources, the chief factors are said to be the placing of young men in charge of important enterprises and the educational methods. The technical schools, though highly

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praised, are said to be no better than those in Great Britain, but in regard to secondary education the article proceeds: "So far as I can see, the American system is more truly educational, less pedagogic; the child is made to learn, I will not say things that are useful, but things that more develop his intelligence and reasoning faculties. I think any average Englishman of middle age, whether of a public or private school, who looks back on his school days must be struck by the vast amount of time and tears he spent in acquiring knowledge which he has entirely forgotten. "But the acquiring of this knowledge," it is said, "has developed his reasoning powers and strengthened his memory." The latter, no doubt, is true, and no one would undervalue memory. But the memory so acquired is of a description that is the least useful in the business affairs of life. Let us take a single example. Perhaps the most marvelous exhibition of memory is that displayed by players of blindfold chess; but who would select a man, because he was an expert in this science, to conduct a business? In regard to the claim of development of reasoning powers, it may be that the absolute reverse is the truth, and to learn by rote things that have no meaning to the learner is possibly the surest way to stunt the intellect. The most valuable intellectual gift a man can possess—I speak with all deference, not as an educationist, but as an engineer—is the power of concentrating his mind on the problem immediately before him; and the learning of meaningless or objectless things—they need only be meaningless or objectless to the learner—is the surest way to cultivate a discursive mental habit. Let any one who doubts this watch an average school boy getting by rote a Greek verb or any other lesson equally empirical. The most trifling incident will distract his attention, and that not from wilfulness, for the penalty of not knowing his lesson has many real terrors. Educational methods, I know, have improved and are still improving in this country, but when all is said I attribute the greater mental alertness of Americans, especially American middle-class youths, to the lead that American schools have taken in this respect.

UNIVERSITY AND EDUCATIONAL NEWS.

According to press despatches, Professor E. A. Ross, lately professor of sociology at Leland Stanford Junior University, has been appointed professor in the University of Nebraska and Professors G. E. Howard (history), William H. Hudson (English literature) and G. N. Little (mathematics) have resigned their chairs at Stanford University.

The latest benefaction of Dr. B. K. Pearons's is reported to be $200,000 for Beloit College, conditional on the raising of $150,000 more by June 15th.

Warren A. Wilbur, of South Bethlehem, has given $5,000 to Lehigh University for the equipment of a mechanical laboratory.

An anonymous gift of £50,000 has been made to the Woman's Agricultural College at Reading, England.

In order to limit the crowding of the medical profession in Germany, the Government has introduced a bill regulating entrance to the medical profession, prolonging the period of study to five years and enlarging the subjects upon which the examinations are based.

The Agricultural School at Berlin has been injured by fire due to an explosion of gas. The loss is estimated at $15,000, in addition to the destruction of valuable collections.

Dr. Winthrop Ellsworth Stone has been elected president of Purdue University. He has been professor of chemistry in the institution since 1889, and vice-president since 1892.

It is said that Dr. George Edgar Vincent, professor of sociology at the University of Chicago, has been offered the presidency of Northwestern University.

Miss Laura D. Gill, A.B., A.M. (Smith College), has been appointed dean of Barnard College, Columbia University.

Dr. John E. Weeks has been appointed to the professorship of ophthalmology in the New York University and Bellevue Hospital Medical College made vacant by the death of Dr. Henry D. Noyes.

Austin M. Patterson, A.B., (Princeton), Ph.D. (John Hopkins), has been appointed instructor in chemistry in Centre College, Ky.